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Popular Science

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Rich Rewards for Arctic Pioneers—By Stefansson

JANUARY

Is Oil for House Heating Cheaper than Coal? (Page 67)

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POPULAR SCIENCE MONTHLY

JANUARY, 1923; Vol. 102, No. 1
25 cents a Copy; $2.50 a Year

Published in New York City at
225 West Thirty-ninth Street

Help Save Radio!

ON THE grounds of a charming country lodge in a little Virginia town there stands a queer looking loudspeaker, made of stone and cement. When concerts from broadcasting stations are on the air, strains of superlative music float out over the countryside from the mouth of this great horn, and are enjoyed by villagers a mile or more away!

Armstrong Perry tells in the next issue of POPULAR SCIENCE MONTHLY how he discovered this loudspeaker and its remarkable inventor.

IN THE same issue, Dr. M. I. Pupin, famous inventor and professor at Columbia University, will tell of a wonderful new project to broadcast a college education for the benefit of millions who are now denied the advantages of a university course.

Christmas, 1922, has been called "the first radio Christmas." Radio receiving sets have come to the fore among the most desirable gifts. At the suggestion of POPULAR SCIENCE MONTHLY, plans were being made as this issue went to press for nationally broadcasting on Christmas Eve the old Christmas carols.

ELSEWHERE in this issue you will read how the activities of a thousand snowbound workers on a great Los Angeles water supply project are being directed by radio. At the suggestion of POPULAR SCIENCE MONTHLY, a special Christmas radio entertainment has been arranged for these men, marooned for months in the mountain fastnesses.

Now—isn't your imagination fired by the variety of such practical applications of radio as those sketched above? But, wonderful as these possibilities of radio are, the development of wireless broadcasting today as a great new institution of public service is seriously hampered—simply for lack of Federal legislation. Whether radio is to remain in its present state of confusion, or to realize fully the tremendous opportunities which POPULAR SCIENCE MONTHLY has for a year and a half predicted, will partly depend on public opinion.

Your aid is needed to help save broadcasting from its present difficulties. Read the editorial note on page 28 of this issue, telling what YOU can do about it.

More than 100 Important Articles, Including:

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POPULAR SCIENCE MONTHLY

Issued monthly. *Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, $2.50; foreign countries, $3.*

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H. J. Fisher, *President*; R. C. Wilson, *Vice-President*
O. B. Capen, *Secretary and Treasurer*

Health in Your Home

SELDOM has a magazine article created more immediate and widespread interest than one in last month's issue of POPULAR SCIENCE MONTHLY by Harry A. Mount, entitled, "Why Our Homes Breed Winter Sickness." Mr. Mount explained astonishing health facts—long known to science, but hitherto ignored by the public—concerning the importance of humidity in the air we breathe, and suggesting effective methods of preventing colds and even more serious illness.

Mr. Mount's article has won the commendation of leading national authorities on ventilation and health, among them E. Vernon Hill, of Chicago, noted specialist in heating and humidifying apparatus, who writes:

"The discussion in POPULAR SCIENCE MONTHLY of the real meaning of humidity in its relation to temperature, is desirable and timely. Every householder should obtain a practical wet bulb thermometer, to make a diagnosis of air conditions in his home."

MR. E. P. LYON, dean of the Medical School of the University of Minnesota, writes:

"I have looked over the article on humidity in your December issue. I agree with you that this is a very important topic. Any humidity device, to be really useful, must be automatic, since an ordinary house may take from 15 to 20 gallons of water a day, and no housewife is going to carry that amount to hand-filled humidifiers."

An Ideal Gift for a Man

THERE is one Christmas gift that will bring more pleasure, will give more valuable ideas, will be more appreciated than anything costing three or four times as much.

It will be used and enjoyed during the whole of next year. It will bring every month new ideas, new inspiration.

It is Popular Science Monthly for 1923.

For One Subscription Send $2.50.

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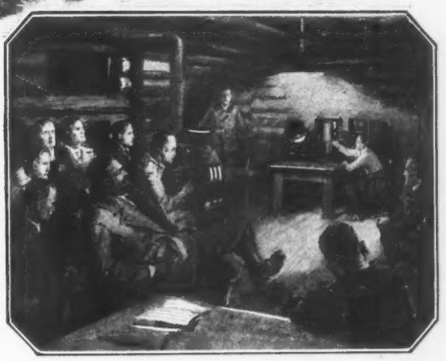
$4.00 for two subscriptions.

ART COLOR PRINTING CO., NEW YORK

Where Radio Brings Cheer to Snowbound Workmen

From an actual photograph of one of the five radio huts where special holiday entertainments, broadcasted from Los Angeles stations, are enjoyed by 1000 men in construction crews of the Southern California Edison Company, snowbound in the high Sierras



PICTURE a cluster of rude shacks almost buried in snowdrifts at a bleak, isolated spot nearly 10,000 feet above sea level in the snow-capped Sierra Madre Mountains of California. It is Christmas Day.

Suddenly the door of one of the shacks opens, and from within comes the blare of a band striking up a lively tune. Rough voices of rough men chime in. Radio has flung a world of cheer upward through the air to this pinnacle of desolation—and has made it sing!

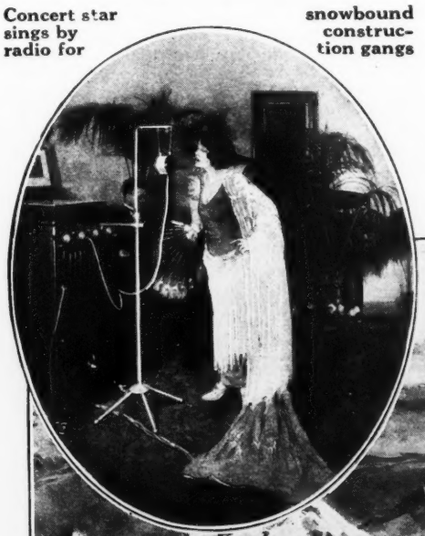
That snow-imprisoned cluster of shacks is one of five far-flung outposts of the Southern California Edison Company in the construction of a great hydro-electric project, in which an entire river is being moved from its course and poured through a three-mile tunnel.

And the execution of this engineering achievement, described and illustrated on page 28 of this issue, is made possible in a large measure by radio, which has provided unfailing communication not only in transmission of orders from headquarters to isolated outposts, but in bringing the cheer of the outside world to a thousand snowbound workmen

Here we have not only the first large scale application of radio to a vast engineering undertaking, but also the realization of one of the visions of radio as a worldwide messenger—visions with which POPULAR SCIENCE MONTHLY stirred readers' interest at the very start of the radio boom, a year and a half ago.

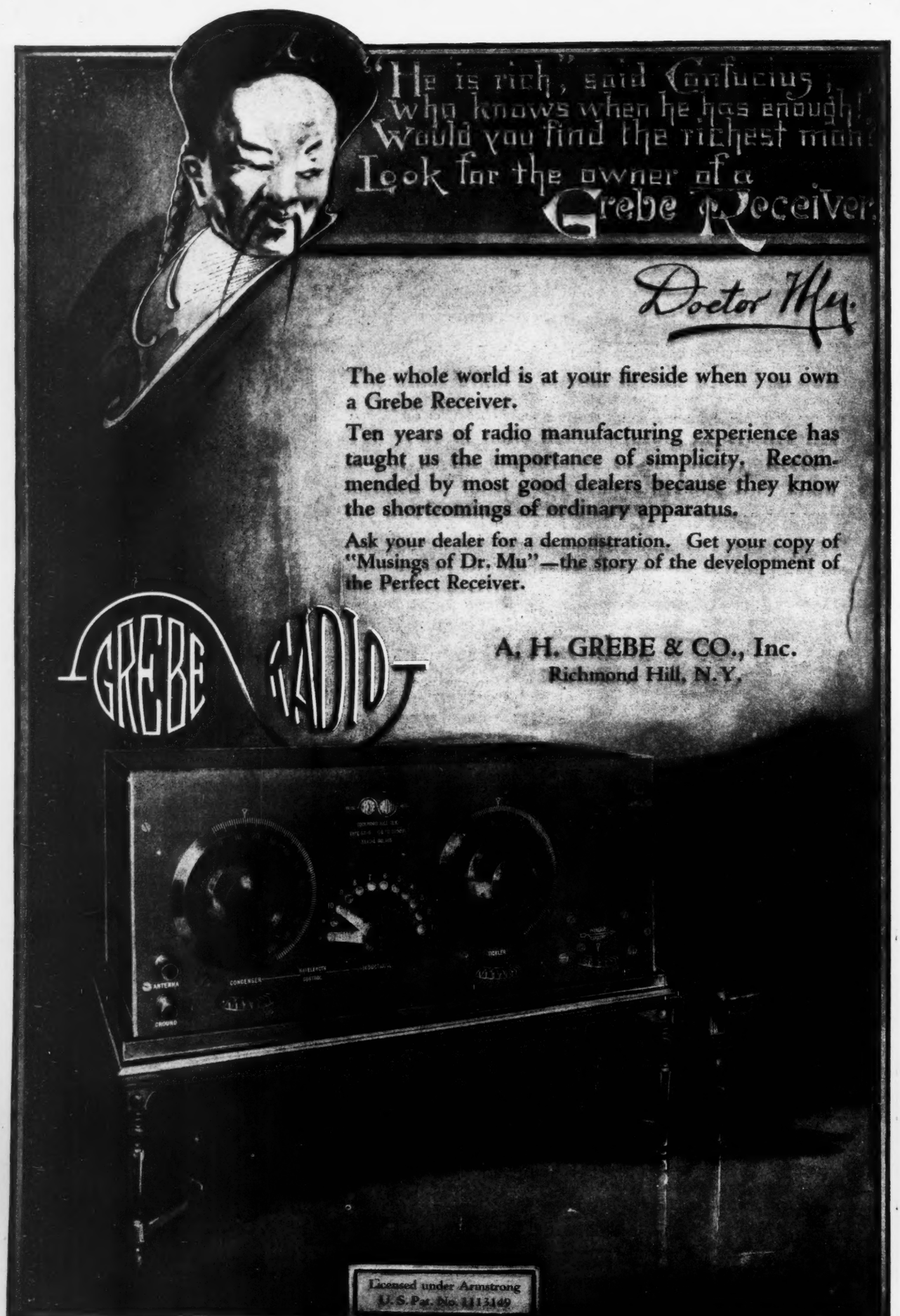
At the suggestion of POPULAR SCIENCE MONTHLY the broadcasting of special holiday entertainment to the snowbound construction crews in the Sierras was carried out by the Southern California Edison Company through arrangements with Los Angeles broadcasting stations.

Concert star sings by radio for snowbound construction gangs



News once went weekly by dog sled—now daily by radio

This map shows the far-flung outposts of the Southern California Edison Company, where isolated construction crews, reached only once a week by dog sled as they work on an immense hydroelectric project, are giving radio its first great test in vast engineering enterprises. These men receive hourly radio instructions, as well as daily broadcasts of news and entertainment


"He is rich," said Confucius, who knows when he has enough! Would you find the richest man? Look for the owner of a Grebe Receiver.
Doctor Mu.
The whole world is at your fireside when you own a Grebe Receiver.
Ten years of radio manufacturing experience has taught us the importance of simplicity. Recommended by most good dealers because they know the shortcomings of ordinary apparatus.
Ask your dealer for a demonstration. Get your copy of "Musings of Dr. Mu"—the story of the development of the Perfect Receiver.
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POPULAR SCIENCE MONTHLY
JANUARY, 1923

"Go North, Young Man!"

Rich Opportunities Awaiting Arctic Settlers across the "Last Frontier"

By Vilhjalmur Stefansson

Famous Arctic Explorer and Scientist
(As interviewed by A. A. Coates)

THE man who wrote, "Westward the course of empire takes its way," had in mind the progress of civilization for the past few hundred years only. If he had surveyed the trail of mankind from earliest history, he might have written as truly: "*Northward* the course of empire." For, as far back as the reliable tradition of man runs, we see the centers of power and prosperity moving steadily from south to north.

Fifty centuries ago corner lots in Egypt were at a premium. Land in Babylon at that time was cheap. Ten centuries later Babylon was the hub of the world. The great center of life and power had moved north. From Babylon it moved farther northward (and westward) to Phoenicia, then northward again to Greece, and northward still farther to Rome. With the fall of the Roman Empire and the coming of the Middle Ages, Florence and Venice flourished. Then France, under the Louis, held the reins of power, only to lose it again to Britain just before the United States became an independent nation.

And now the admitted leadership of the world lies in the hands of the English-speaking peoples. Where will it go next? I think there is little doubt that it will continue its course in the same general direction as it has the past 50 centuries, until it is arrested by the Arctic Ocean.

The Far North today is the greatest and the last remaining frontier in the world. Yet our modern civilization, accepting false ideas of the unknown, just as each successive civilization has done before, has held back from the North in the belief that it is a dreary, uninhabitable waste.

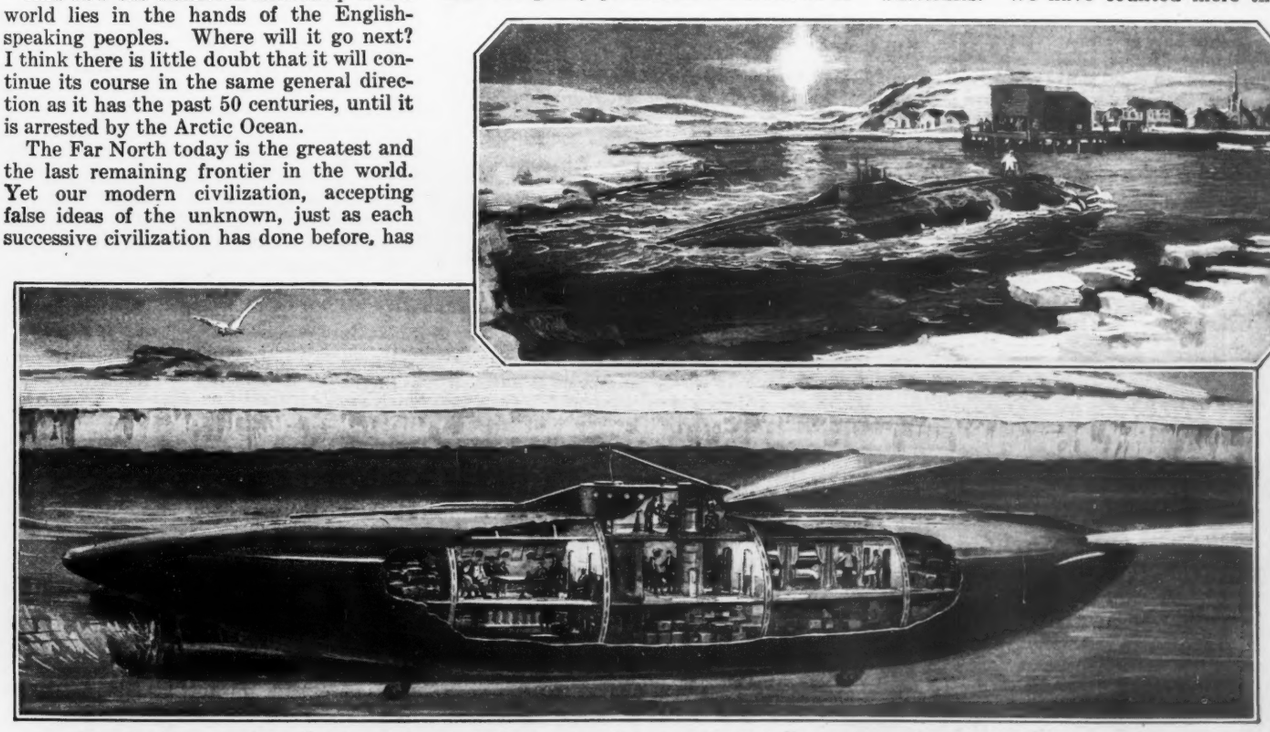
Vilhjalmur Stefansson

Explorer and scientist, who sees in the "last frontier" of the North a future world center of civilization and wealth

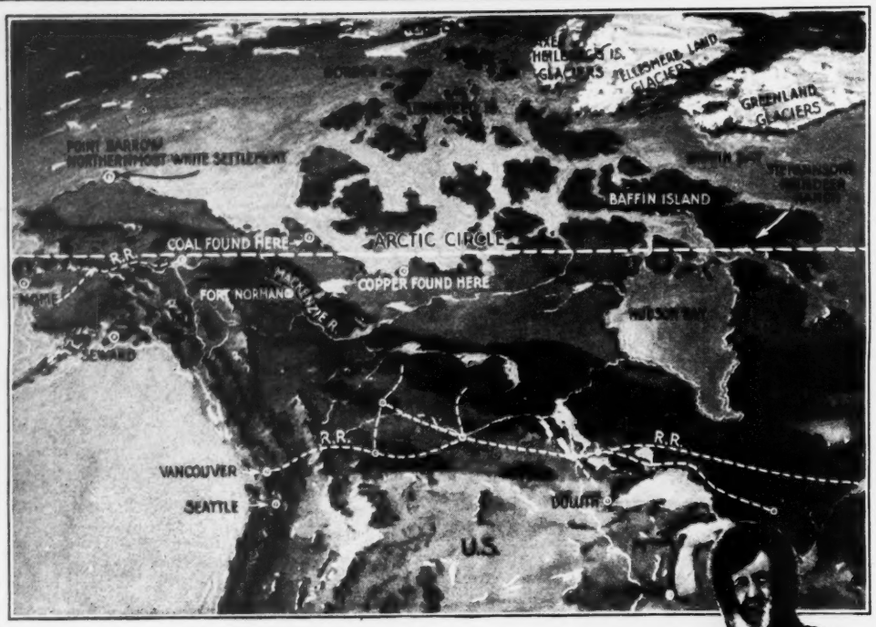
Photo Courtesy New York Zoological Park

The Ovibos, or "sheep cow," of the Arctic regions, which Stefansson predicts will play an increasingly important part in supplying the world with meat and wool. The bull Ovibos usually weighs more than 700 pounds. The meat of these animals is much like beef, while experiments show that their heavy wool can be manufactured into excellent unshrinkable cloth

We who have lived in the region of the Arctic Circle know it is nothing like the icy waste pictured by popular belief. We have seen the grassy prairies in the shadows of huge glaciers at Ellesmere Island, north of Baffin Bay—the northernmost land in the world. In summer we have found the gentle slopes golden with flowers, green with grass and swarming with bees and butterflies. We have counted more than



How Stefansson pictures future transportation across the polar seas by submarine ferryboats which will speed below miles of ice crust, rising to the surface in free water at port. "Submarine ferries are practical for year around communication between ports that are icebound in winter," says Simon Lake, famous inventor of submarines. "For years I have advocated this method of winter navigation in the Great Lakes, the Baltic, and far northern seas."



A Trail Blazer of the Arctic Frontier

TO VILHJALMUR STEFANSSON, venturing across the polar pack, living "off the country" for months, and penetrating to arctic lands where white men were unknown, belongs much of the credit for opening the eyes of the world to the potential wealth of the Far Northern Empire. The vast expanse of this "last frontier," with its untouched hoards, and its wealth of broad grassy prairies, is shown on the map above, on which are indicated also the present railway routes by which adventurous settlers may travel to this land of opportunity.

The dark strip running across the center of the map represents the northern tree line of the American continent, close to the Arctic Circle, while the gray portion of the map above this line includes the wide areas of mainland and the numerous islands which, Stefansson tells us, contain a wealth of minerals, also sweeping prairies, ideal for reindeer and Ovibos.

Stretching northward to the shadows of the polar glaciers, all of this gray territory, revealed to the world largely through Stefansson's explorations, is open to profitable settlement. Indeed, Stefansson himself and associates control an immense tract of grazing land in the southern half of Baffin Island, where they have established the nucleus of a great reindeer herd.

The photograph at the right shows Stefansson, the pioneer arctic settler. Born of a family of pioneers who were among the earliest of farmer colonists in Manitoba, Stefansson as a boy dreamed of becoming a Robinson Crusoe—an ambition which he was to realize later. Attending the University of North Dakota and the State University of Iowa, he turned to scientific study of the history and life of mankind, becoming an assistant instructor in anthropology at Harvard University in 1904. In that year he made his first expedition to Iceland.

Stefansson's most brilliant and adventurous journey was undertaken in 1914 when, as commander of the Canadian Arctic Expedition, he and two companions made a 600-mile sled journey over broken and moving ice from Martin Point, Alaska, to the northwest of Banks Island. This daring expedition was followed by the discovery of a new land north of Prince Patrick Island and of new islands far above the Arctic Circle. On the map are indicated three discoveries credited to Stefansson—Meighen Island, Border Island, and Lougheed Island. These explorations contributed much to scientific knowledge.

Eskimos at Nome dressing reindeer for United States markets. The North, Stefansson says, is destined to be the world's meat raising center

700 species of flowering plants north of the Arctic Circle. We have watched great herds of reindeer and Ovibos, or "sheep cows," as they grazed over fertile prairies—promising a bountiful supply of meat for years to come.

We have seen the rich natural resources of this untouched empire, and we know now that since it has all been explored and mapped, the age of colonization is at hand, bringing with it the hope of relief from the congestion which is a growing menace to our civilization.

Naturally there are difficulties to settlement, as in all pioneering, yet the northland is fairly accessible. You can buy tickets, if not in New York, certainly in Winnipeg, to take you by railway and boat (on the Mackenzie River) clear to the Arctic Ocean. The railway runs now to McMurray, Alberta, where it connects with the boat line on the Mackenzie, and, barring portages at rapids in a few places, the trip is then made entirely by water, cheaply and easily.

Not for Sightseers

The Mackenzie is open to navigation during the polar summer and offers a direct route to Point Barrow, the tiptop of Alaska. However, I should not recommend the trip for sightseeing alone. To the traveler the voyage is not especially picturesque—just about like traveling up the Missouri River, with little scenery except high banks, generally forest clad.

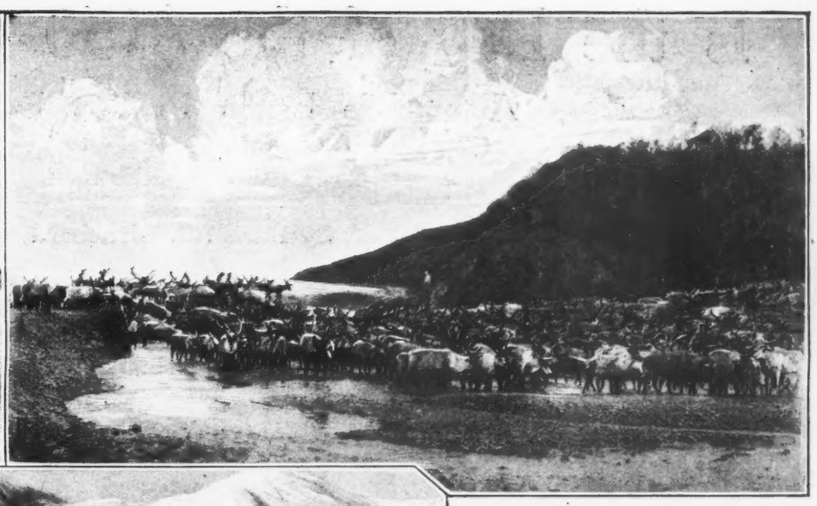
The journey overland is not so simple. It is about like crossing Nebraska before roads were built. In the summer the ground is soggy and soft, so that wheels are nearly useless. Here, in time to come, the endless tread tractor will be extremely useful. In certain parts of Alaska already they are being used to haul lumber, and they can be operated successfully in almost any polar region. We have done most of our overland traveling in the winter, for even where there is little snow, the sleds slip over the frozen ground; and when you come to a frozen lake, crossing it becomes a real pleasure—like snowshoeing in upper New England.

We hunt as we go, and therefore we need carry few provisions. Caribou are found all the way from the fringes of civilization on the south to such northern lands as Melville Island and Borden Island. Then there are Ovibos, the northernmost land animals in the world—a sort of cross between cow and sheep. They may be found clear to the north tip of Greenland, and hunting them is about as easy as hunting a herd of cattle in a meadow.

Railways Needed for Settlement

When railways are built into the Far North, settlement will be simpler. Keeping railroads open during the long winter months will not be as difficult as it is in the American and Canadian Northwest today, for there is much less snow as you go north from the international border and east from Alaska. You have more snowfall during

This caribou, mingling with a reindeer herd, eventually became tamer than the domestic deer and was used to "ride the range." Enormous herds of wild caribou (one herd was estimated at more than 3,000,000 animals) migrate to the furthermost limits of the Arctic



More than 100 herds of reindeer like that shown above, are scattered over Alaska and include about 250,000 animals. At least 100,000 have been butchered for meat and skins. The photograph at the left shows how reindeer are used to haul loaded sleds

the average winter in St. Louis or Richmond, Va., than we do on the northern tip of Alaska.

The growth of air transit—commercial and passenger service—will simplify the problems of the north tremendously. Much of the polar basin lies in direct lines of transit between great centers of power and population, such as London and Tokio. With air transportation, islands in the polar archipelago such as Banks, Melville, Victoria, North Devon, and Prince Patrick, which are dangerous for steamships to approach, because of floating ice in the sea, would be put into direct communication with the rest of the world.

The steady advance of empire northward into cooler, more invigorating air—a march which, according to Stefansson, has coincided with that of civilization—is illustrated here. Average annual temperatures of succeeding world capitals are indicated

Freight and Passenger Submarines

Submarines, too, promise a successful means of quick transportation; for submerged power boats would be able to cruise along under the floating crusts of ice, rising to the surface in clear water in port. In the light of recent experiments along this line, it is not too much to expect that some day the greater northern islands will be served by a system of submarine ferries, giving transportation as adequate as the surface ferry system now in use across the English Channel.

By far the greatest difficulty in colonizing the North will be the necessity for colonists to change their viewpoints and their habits in many respects. We are, most of us, an agricultural people, and we have grown accustomed to raise certain crops in certain localities. For that reason when we move to a new place, especially a place where climatic conditions are radically different from those to which we are accustomed, we are inclined to be disgusted with the new place because there we cannot grow what we grew at home. When the first settlers came up from Louisiana to settle southern Illinois, they found they could not raise sugar and cotton there, so they went back home after a year and said the new land was a howling wilderness and incapable of supporting human life. Yet we know now that Illinois is good for quite a few things, even if it has no balmy Januarys and will never be worth anything as a cotton field or sugar cane plantation.

Settlers must learn, as I had to, first of all, to utilize nature as they find her, and not try to bend her to their uses. They must discover first what the land will produce and then set about producing it. Now, the polar region will not grow cotton or wheat or tomatoes, but it will grow most garden vegetables, and, most important of all, meat.

The North Has Its Strawberries

When I made my first journey down the Mackenzie River in 1906, I saw strawberries successfully cultivated in gardens of the Mission at Fort Providence, 500 miles north of Edmonton, Alberta. At Fort Good Hope we bought potatoes that had been raised practically in the Arctic Circle, and I have talked with traders who raised carrots and cabbages in the Mackenzie delta, fully 100 miles north of the Arctic Circle. Yet, while it is true that most of the common garden vegetables can be grown in about

(*Continued on page 100*)

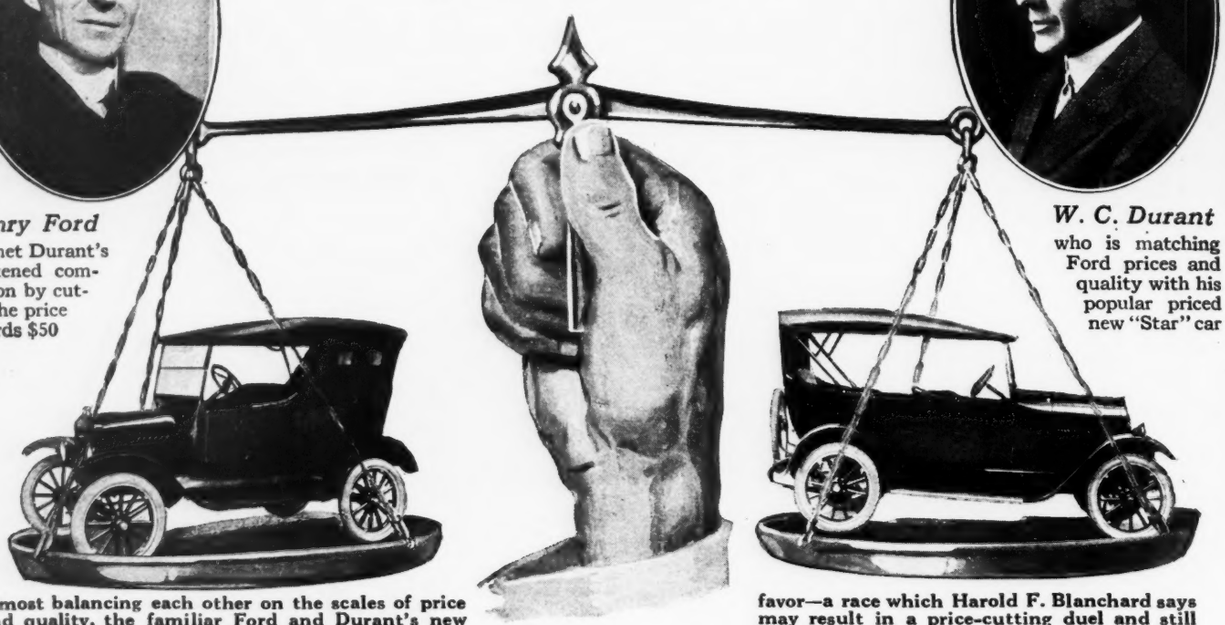
Is the Day of the $150 Car in Sight?

Automobile Expert Predicts Era of Still Cheaper Autos as Ford and Durant Clash in Spectacular Price Cutting Duel

By Harold F. Blanchard

Henry Ford
who met Durant's threatened competition by cutting the price of Fords $50

W. C. Durant
who is matching Ford prices and quality with his popular priced new "Star" car



Almost balancing each other on the scales of price and quality, the familiar Ford and Durant's new "Star" (at right) are matched in a race for popular favor—a race which Harold F. Blanchard says may result in a price-cutting duel and still cheaper cars for everybody

WE ARE facing revolutionary developments in automobile manufacturing and automobile price cutting, such as we have never known before! At least two distinct groups of automobile manufacturers are girding themselves for the battle, and there are rumors that a third may enter the field. Already W. C. Durant, the man whose business genius made possible General Motors, Chevrolet, and the Durant Company, has thrown down the gauntlet, and Henry Ford, until now supreme in his field, has taken it up.

The public stands to win—no matter who else wins or loses—and the question of the hour is: *"How low will automobile prices go?"*

Personally, I believe the $150 car is a possibility. I believe that the present state of industry makes it possible. There is an air of impending drama right now about the whole automobile industry. A year ago, some automobile manufacturers who were not so far-seeing as others, were worrying about what they called "saturation." They feared that the production and sale of automobiles had reached their highest points. Today they realize that their fears were groundless—that there is no such thing as the saturation point so far as the sale of autos is concerned, provided the lowering of prices keeps pace with increased production.

There is little doubt that the production of automobiles in 1922 exceeded all records. In 1920, 2,276,000 cars and trucks were produced. And in 1921, although numerous contributing factors made it seem impossible to reach that figure, the record was excelled.

Up to October, 1922, 1,873,000 cars were produced. The month of October added another 244,000—44,000 ahead of the best previous October record. On top of this, there is the prospective duel between Ford and Durant and the possibility of a third great price cutter entering the field, with consequent increase in demand for automobiles.

So far, the Ford-Durant war has developed with only a passing stir of public interest. Here is a really dramatic event and it is almost unnoticed. Never before has an automobile manufacturer challenged Ford in his own field. But now comes Durant and meets Ford quality and price. And so alert has Ford been to this—his first real competition—that he startled the country this fall with his famous $50 price cut, making Fords cheaper than many phonographs and radio sets.

More than a year ago there were rumors about Durant's new "Star" car. These were followed by Durant's spectacular sales campaign. There was some speculative talk about a Ford-Durant war, but both men were silent on the question. Then came further speculation as to who, besides an indefinite, vague "Wall Street," was back of Durant and his projects. Most people failed to take him seriously—most people except Henry Ford. And in the meantime, Durant Motors, Inc., has placed on its books orders for 300,000 more cars than it can produce in the next 14 months despite its scheduled annual production of 231,000 cars.

W. C. Durant's career from its beginning to the present time has been spectacular. A grandson of Governor Crapo, of Michigan, he worked his way up in the lumber mills where he was first employed, learning the lumber business from beginning to end. At the age of 21 he had earned for himself a place as one of the executives of the mill by his remarkable

Better Highways Mean Cheaper Cars

By William C. Durant,
President of Durant Motors

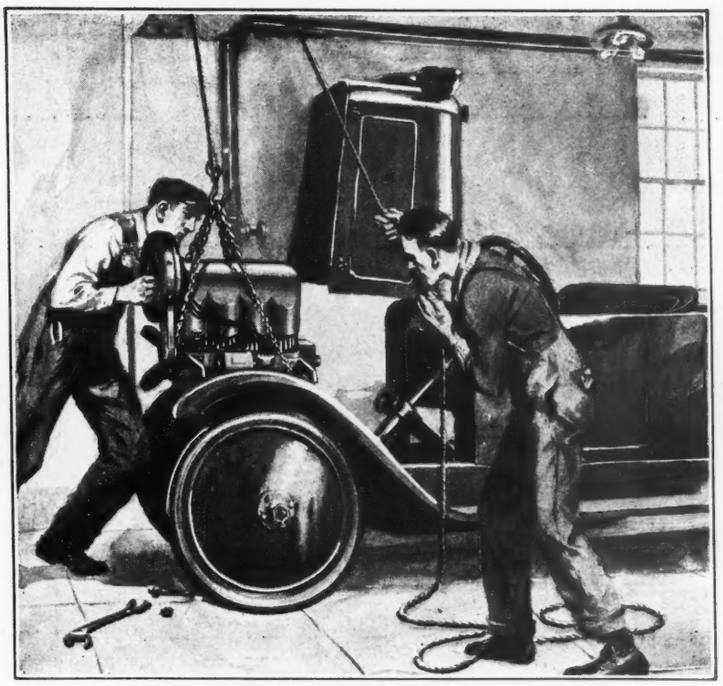
THE motor car business is still in its infancy. Development of the automobile is only in the experimental stage. The next 20 years should witness an expansion of automobile manufacturing more marvelous than that of the two decades through which we have just passed. Automobile development should parallel that of the development of our railroads.

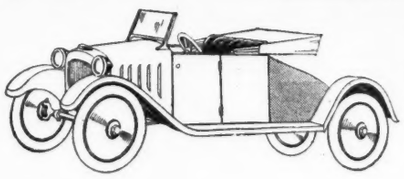
Not so long ago, railroads were at the stage where they built around obstructions instead of eliminating them. Then they succeeded in making their rail lines straight and comparatively free from steep grades, thereby paving the way for rapid transportation and the enormous development of railroad traffic.

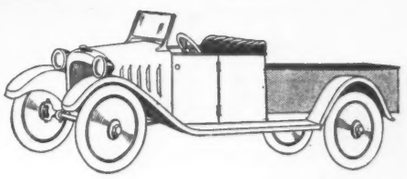
The same thing is happening now to automobile highways. Our motor car of today is built to withstand hard usage because our highways make this necessary. Most of us will live to see the country covered with a network of comparatively level highways. And, when we do, radical changes in construction of the automobile will be possible. Less powerful, and therefore lighter engines will suffice. And with lighter engines the entire automobile construction will be lighter and cost far less.

Many of the structural changes will be radical, and a large percentage of the present weight of a motor car may in this way be eliminated. Every highway that is built creates a new market for the automobile and we have just started to build roads.

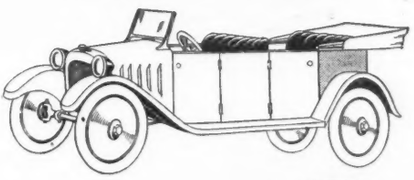
ability to grasp fundamentals of business. Turning to other fields, he rescued a cigar concern from financial death by injecting efficiency and enthusiasm into the business. Then, seeking a larger opportunity for himself, he assumed the management of a demoralized waterworks company, placing it upon a sound financial basis. Now began his real career as a vehicle manufacturer. Seizing an opportunity to become a partner in a company manufacturing two-wheeled carts, he soon developed the company to a point where it was turning out carts at the rate of 100,000 a year. But that success did not satisfy him, for he had visions of the tremendous possibilities of the baby automobile industry. And so, with $15,000 capital and a new automobile engine invented by a farmer whose name was Buick, he began to manufacture automobiles at Jackson, Mich.



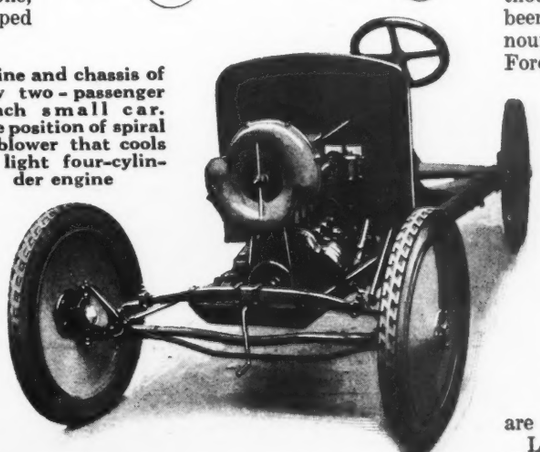




The illustration above shows possible cost saving features of the $150 car, as predicted by Harold F. Blanchard—engine, storage battery and generator in one unit that can be lifted out easily for repair; hood and dummy radiator in another unit that swings back to permit access to engine. The accompanying drawings show roadster, touring car, and truck models

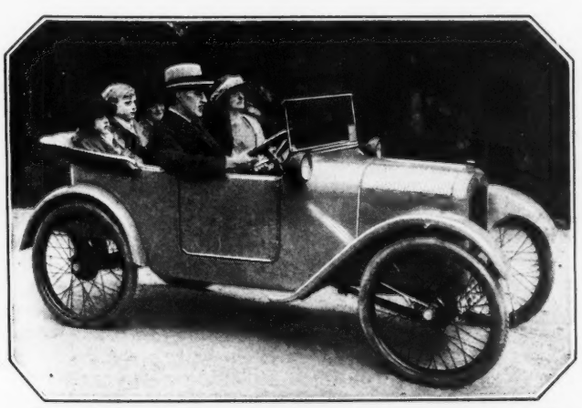


It wasn't long until the name of Buick was known the world over. The next step was the purchase of Cadillac, Oldsmobile, and Oakland plants. Durant wrapped these plants up in one package and called it "General Motors." Because he needed money to finance this venture, he turned to Wall Street, where astute financiers gave him the money, but acquired control of the company. Then Durant worked out a plan to regain control of the company for himself—a plan that worked so well that Wall Street was astounded. More than that, Wall Street kicked itself when in 1915, with Durant in control of most of the stock, General Motors paid a dividend of $50 a share!



Engine and chassis of new two-passenger French small car. Note position of spiral air blower that cools the light four-cylinder engine

Meanwhile, he had consolidated Chevrolet with General Motors and had built up that concern until in 1920 it boasted of 23,000 employees, 12,000 dealers, and over 60,000 stockholders. At that pinnacle of success he broke away from the corporation, resigning the presidency of General Motors to organize Durant Motors, Inc. During the first nine months of his new venture he booked $31,000,000 worth of business and sold 30,000 automobiles. What new spectacular feat he will accomplish in the future remains to be seen. But certain it is that he is one of those who see the possibility of automobiles becoming as common as watches and as cheap in comparison with present-day automobile prices as dollar watches now are in comparison with the prices of watches of other days.



This new English four-passenger light car, only 8 feet 8 inches long, and weighing 650 pounds, has all the up-to-date equipment of a full-sized touring car

"The development of a cheaper car than we now believe possible is only a question of the development of highways," says this genius of the automobile world. "Millions more automobiles would be in use in America today if the condition of our highways permitted. When our automobiles can be built to run on highways that are on the average as good as our city streets—and this is bound to come sooner or later—we shall have lighter, better, and far cheaper cars. And that time is not far distant."

Speculation as to whether these cheaper automobiles will fall as low as $150 is timely in view of Henry Ford's recent cut in his prices. When Ford dropped the price of his roadster to $319, and the touring car to $348, most people thought that rock bottom in prices had been reached. But just then Durant announced his "Star" at Ford prices and Ford quickly came back with his $50 cut, this time lowering the roadster price to $269 and the touring car price to $298. All this took place *despite the fact that labor and material were still much higher than before the war.*

If material and labor were as cheap now as they were before the war, it is reasonable to suppose that the price of the runabout would be closer to $180 than its present minimum of $269. In considering the possibility of the $150 car, however, we have not assumed the likelihood of any such reduction in cost of labor and material. Rather, all our assumptions are based on present costs.

Let us go back and analyze events that have led to the $269 price for Fords. Fourteen years ago, when the present Ford "Model T" was announced, it sold for about $1000. It now sells for $298, and far excels the 1909 model.

Why Prices Have Dropped

The difference is due to two factors—increased production and vastly more efficient manufacturing methods. In 1909 the production was 13,000 cars—a figure that was considered tremendous at that time. Now the Ford factory turns out that number in *less than three days*—the average daily production is about 5000 cars—while a yearly production of 1,500,000 is a conservative expectation.

Such a record has been made possible by extraordinary improvements in machine

(*Continued on page 90*)

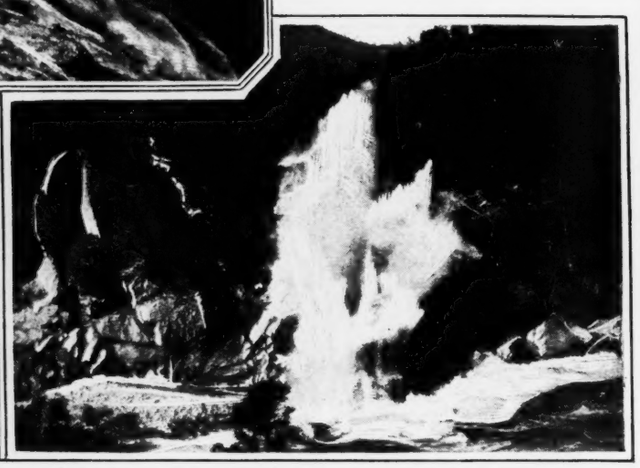
How Engineers Moved a River through a Mountain

DIVERTING a river from its natural bed and turning its flow into a great three-mile tunnel blasted through a mountain, engineers of the Southern California Edison Company have successfully averted a serious power shortage that threatened to d'm the lights in a million homes in and about Fresno, Calif.

A Race with Time

This unparalleled engineering feat, part of a gigantic hydroelectric project, was accomplished by tunneling through three miles of solid granite of one of the Sierra Madre mountains, about 40 miles north of Fresno, and leading the waters of the San Joaquin River to a point where a sheer drop of 680 feet could be obtained for the operation of water turbines. The original plan was to extend the tunnel to a point where a head of 1500 feet could be obtained, but time did not permit this. Each day the shortage of power and light was becoming more critical. It was a case of rush work or a city thrown in darkness. Therefore it was decided to utilize only a portion of the available power by immediate construction of a power plant.

The nerve center of operations. From this radio room at the Cascada headquarters camp in the high Sierras, engineers of the Southern California Edison Company direct the work of 1000 men engaged in the San Joaquin River hydroelectric power development



The blast that diverted the San Joaquin from its natural channel into a three-mile tunnel under the mountains and thence to the penstocks of the power plant. The upper photograph shows drilling operations to test the river floor

Radio Proves Its Value

Toiling night and day, in three shifts of eight hours each, the workmen attacked the mountain from both ends of the prospective tunnel. In spite of delays caused by the coming of winter, with heavy snows in the mountains, the end of 180 working days saw the long tunnel ready for its first washing.

How the use of radio, providing a means of unbroken communication between engineers in the headquarters supply camp at Cascada and crews of 1000 workmen snowed up in distant outpost camps, aided in this extraordinary race against time, is told on page 21 of this issue.

Wanted—Radio Legislation!

IF RADIO isn't all it should be today, the fault lies partly with each one of us. National legislation is vitally needed. But Congress won't pass legislation on behalf of radio unless *we* demand it. Given legislative encouragement, with some legal leeway in wave lengths, and the broadcasting stations would be fully capable of making radio programs so popular and universal that there would be 15,000,000 receiving sets in use in this country, instead of the estimated 3,500,000.

Ever since last June, the White radio bill has lain neglected in Congress. Radio experts all agree that once the bill goes before Congress for discussion, beneficial legislation will surely result.

All our rosy hopes for the future of radio, following Secretary Hoover's famous radio conference in Washington, have been doused in the cold water of legislative neglect. The interests of millions of present and prospective radio fans demand that Congress speedily take up this matter of radio legislation.

And Congress will act if the public insists. Every reader of this page shares the responsibility for determining whether radio shall continue to languish as it does at present, or to thrive as it might. Write to your congressman—ask that prompt consideration be given to the White radio communication bill. Don't let this slide any longer. Play your part in the encouragement of radio. Write for action. Do it NOW.

While the work of tunneling was in progress, another gang was busy constructing the power house and penstock—a task that was completed just as the tunneling crews reached the end of the three-mile bore. The penstock of welded steel pipe, eight feet in diameter, had been led 2700 feet up the side of the mountain to the place where the tunnel was to break through.

Changing the River's Course

When all was in readiness, the last wall remaining in the tunnel was blasted away, and with a great rush the waters of the San Joaquin River left its bed and passing through the man-made tunnel, washed the loose boulders out of the aqueduct. In an incredibly short time a complete power plant had been built where nature had never intended there should be one. Before power consumption at Fresno had reached the limit of production, a new set of turbines was humming.

Thus passed the crisis in the impending power shortage, marking the crowning effort of a courageous band of men who labored unceasingly for six months at an elevation of sometimes 10,000 feet, cut off by impenetrable snowdrifts from the outside world with which they communicated by radio and dog team.

Huge Power Development

This particular plant is but one of a series of power stations that will make the San Joaquin hydroelectric development one of the world's greatest power producers. A total of eight separate plants will harness waters of the river, utilizing the power produced by gravity in the drop from an elevation of 9000 feet at the source. The system will produce 929,000 kilowatts of electricity, or 1,290,000 horsepower—an output that will be about 70 per cent greater than that of the famous Niagara Falls development.

Great 350-Foot Steel Bridge Sheathed with Cement Shot from Guns

Wire Mesh, Welded on Steel, Holds Protective Coating

ARMED with cement guns, engineers are now completing the stupendous task of "shooting" 60,000 square feet of exposed steel structure with fine grained liquid concrete, coating the 350-foot bridge over the Willamette River, near Oregon City, Ore., with a protective sheath of cement 1½ inches thick.

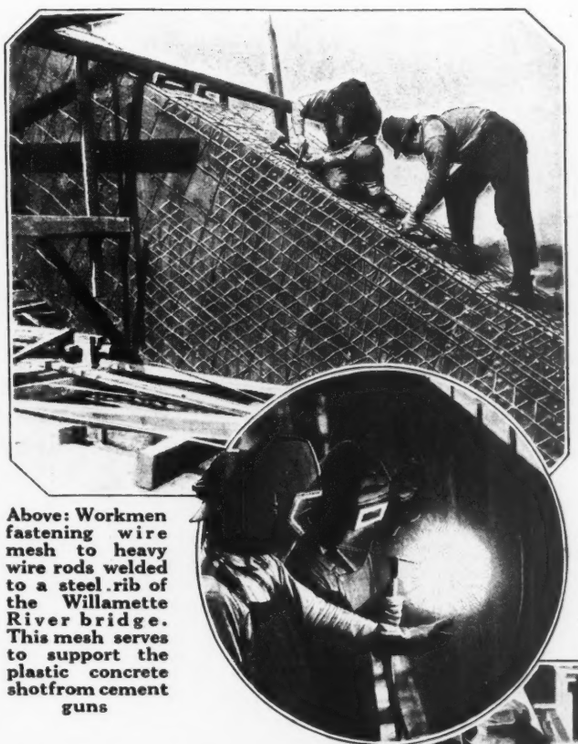
Faced with the necessity of giving the new bridge a covering of concrete and unable to pour the materials in the customary manner because the extreme depth of the river made scaffolding impossible, the engineers determined to overcome the problem by the use of the concrete gun. The protective coating was made necessary by the fact that the Willamette bridge is in the vicinity of several great pulp mills, which liberate sulphurous anhydrid gas. In the presence of moisture, this gas combines with water to form a solution of sulphuric acid that would tend to corrode the steel rapidly.

How Mesh Is Attached

The arch of the bridge rises 100 feet from mean low water. Each steel rib is 2½ feet thick and from six to 10 feet wide. Lines of heavy wire were first crisscrossed and welded directly to the ribs, a task that required nearly 50,000 spot welds. Then substantial mesh was wired to this pattern of heavy wire, completely covering the structural steel and forming the support for the plastic cement. The webbing was welded on rivet heads so that it would stand away from the steel, allowing cement to get behind it and bind the whole together securely. The finished work is practically a perfect amalgamation of steel and concrete.

The operation of shooting the concrete or "gunite" requires skilful work. Cement and dry, screened sand are first mixed with water and fed into the hopper of the gun. The gun receives a pressure of from 60 to 80 pounds from an air compressor and shoots the mixture through a 1½-inch hose. A skilled operator continually apportions the intake and inspects the line for clogging. Since the mixture must sometimes be shot through hundreds of feet of rubber tubing in order to reach the farthest point of the arch, the pressure must be very high.

The steel floor beams and stringers are covered with poured concrete. As a whole the bridge represents the greatest piece of gunite work ever attempted, and if it proves completely successful, will probably stand as a model for future structures of the kind.



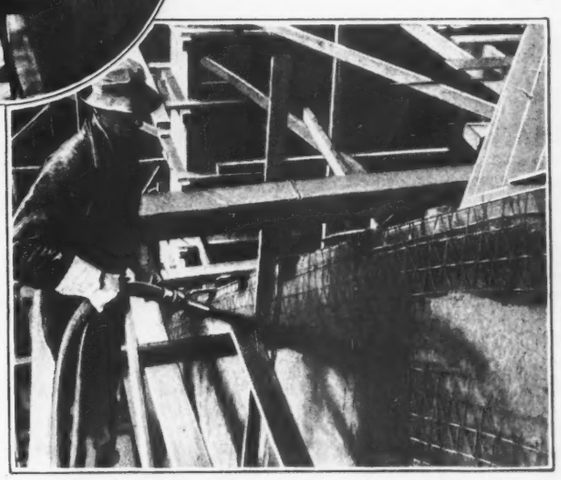
Above: Workmen fastening wire mesh to heavy wire rods welded to a steel rib of the Willamette River bridge. This mesh serves to support the plastic concrete shotfrom cement guns

Courtesy of American Museum of Natural History

Cement Gun Invented by Famous Hunter

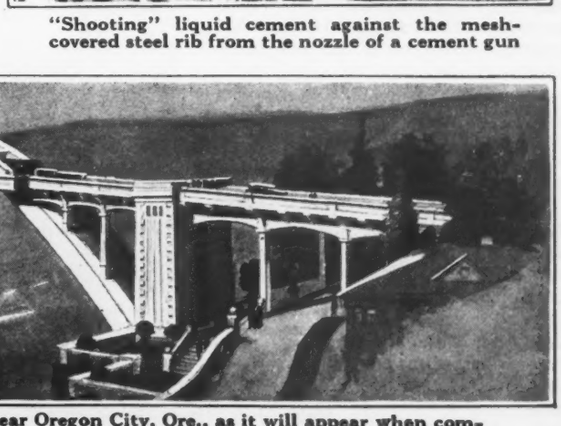
THE modern cement gun, of the kind used in surfacing the steel ribs of the Willamette River bridge, as described in the accompanying article, had its origin, strangely enough, in the mounting of wild animals. It was invented by Carl Ethan Akeley (above), famous wild animal hunter and now taxidermist-in-chief of the American Museum of Natural History, who devised it for the purpose of shooting concrete on to frames he had built for mounting animal skins.

Later, Akeley perfected a larger gun. Its many uses today include the covering of underground mine passages, preventing ground swelling in mines, building walls and fences, covering metal laths and furniture frames, and extinguishing dump fires.

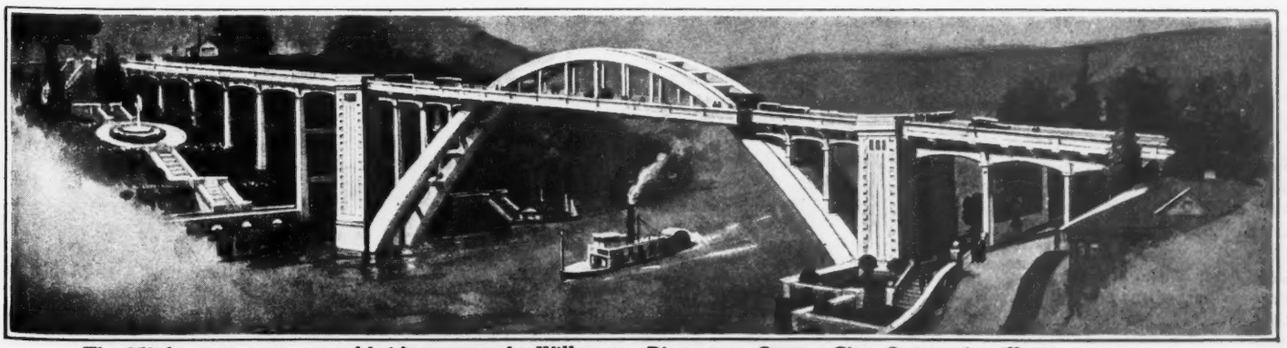


Wearing masks to protect their eyes and faces, spot welders fasten quarter-inch wire rods to the steel, as shown above. The entire job required 50,000 electric spot welds

DID you know that we are in the midst of the greatest era of bridge building in the world's history? In a following issue is described a marvelous cross-city bridge system for rapid transit recently proposed

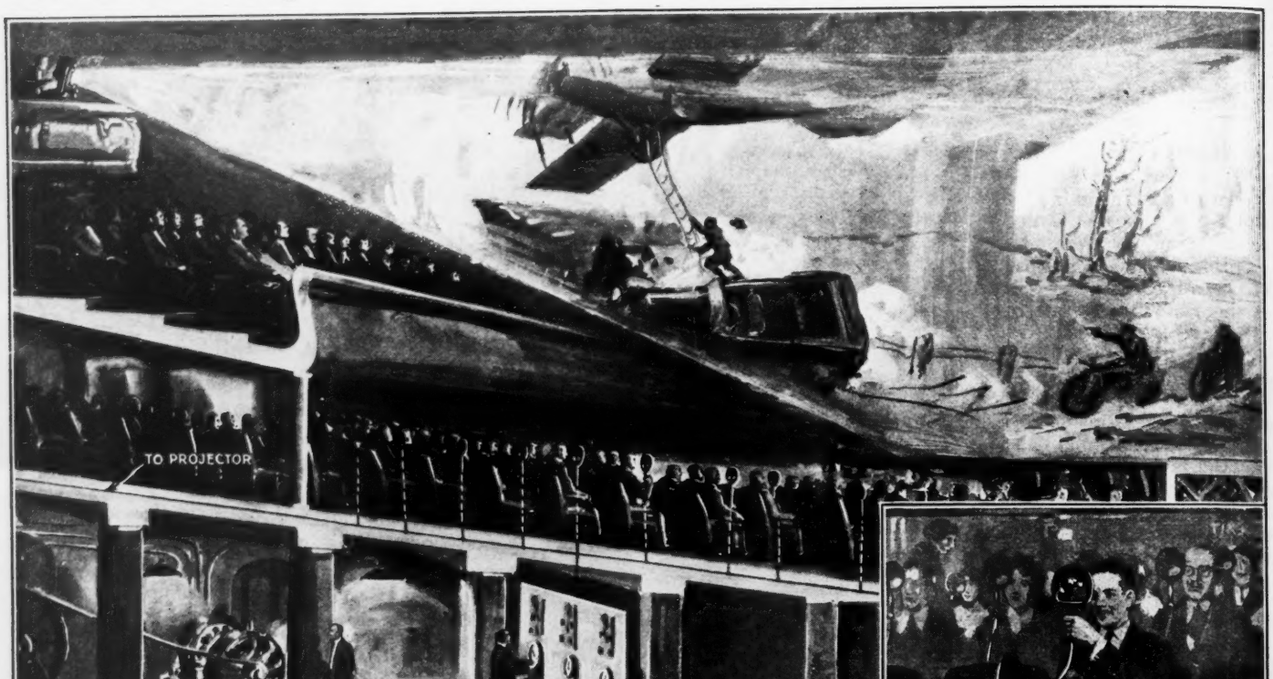


"Shooting" liquid cement against the mesh-covered steel rib from the nozzle of a cement gun



The 350-foot concrete-coated bridge across the Willamette River, near Oregon City, Ore., as it will appear when completely sheathed in concrete. From the architect's drawing

Thrills "Leap from Screen" in Stereoscopic Movies



Viewing a motion picture through the new motor driven shutter device, shown at right, each spectator sees speeding objects fairly hurtling toward him. Operated by alternating current from the same source, the shutter in front of each spectator and the shutter of the movie projector are kept in perfect synchronism

By this motor driven alternating shutter device, double-image pictures are filtered, so that the spectator sees first the "right" picture with his right eye, then the "left" picture with his left eye, as illustrated at left. Once properly adjusted, the device remains in place, and the spectator sits back at ease

STEREOSCOPIC movies are here. And with their coming you may experience the thrill of seeing an automobile fairly leap out of the screen at you.

No less a personage than David Wark Griffith—the great movie producer — declares that perfection of three-dimension motion pictures will do more for moving pictures than any previous development in their history. "Imagine," says Griffith, "movies so real that they would drive startled spectators from their seats, and you will have an idea of what the stereoscopic movie will be like."

The left eye blinded, one sees the "right" picture. Next instant the process is reversed

Such effects have actually been achieved by a young engineer, Laurens Hammond, of New York, who has been showing his new stereoscopic movies to amazed audiences of experts. The most extraordinary effects of distance and perspective are obtained, while facial expressions are made wonderfully lifelike. A photoplay using the new process is soon to be shown in a big New York theater.

The principle of the familiar "still" stereopticon is preserved by the stereoscopic movies. On the camera two films are exposed at the same time, separated by the distance between the average pair of eyes. These films are then printed alternately on the same reel, all the "even" pictures being reproduced from the "left eye" films, while the "odd" pictures are from the "right eye" films.

This stereoscopic movie camera recently demonstrated in Los Angeles, Calif., simultaneously exposes left and right films, which are colored red and green respectively. Viewed through spectacles containing glasses of the complementary colors, the pictures appear plastic and in black and white

Each spectator views these pictures through an observation device containing an aperture, across which a rotating shutter moves. Thus, when a "right" picture is on the screen, the shutter blinds the spectator's left eye, and vice versa. The speed of the shutter's movement is so great as to make it invisible, but a composite impression of the "right" and "left" pictures is registered on the brain, thus duplicating the natural process of seeing in three dimensions.

One of the shutter devices is stationed before each spectator. Synchronization of the shutter and projecting machine is obtained by adjusting the motor, which operates the projector, to run in parallel with hundreds of inexpensive 1¼-inch motors that drive the individual shutters.

It is estimated that the cost of equipping a motion picture theater is about five dollars a seat.

A Modern Chemist's Magic

How a Hobby-Loving Scientist Succeeded, Where Nature Failed, in Creating a Substance Needed by Man and Now Used in Hundreds of Ways in Home and Shop

By Boyden Sparkes

WIRELESS apparatus — airplane propellers—pipe stems—transparent fountain pens—phonograph records—casings for dynamos—telephone receivers—railroad signals—grinding wheels—billiard balls—buttons—even the golfer's brassie.

Can you imagine a single man-made material, unlike anything else on earth, from which all these articles and hundreds more are being manufactured today?

No?

Well, because Dr. Leo Hendrik Baekeland—famous chemist and inventor—*could* and *did* imagine just such a material, his story has become a classic of great achievement in modern science.

A "Hopeless" Problem Solved

I have just talked with this creator of the remarkable substance known as bakelite, now used as the essential toughening ingredient in hundreds of products familiar in every home and office. And I have learned something of the inspiring methods by which this determined scientist, tackling a most baffling mystery of nature, combined two strong-smelling liquid chemicals as if by magic, to form a solid product tougher than amber, resistant to heat, moisture and electricity, and ideal as an insulator.

Sometimes the dreams and labor of many men, throughout years of research, go into the perfection of a single invention. More often, a lucky accident is the source of a new scientific principle or device. But occasionally, a single miracle worker accomplishes in a few months of intense, well-directed effort, the solution of a "hopeless" problem in invention.

Such a modern miracle worker of science is Doctor Baekeland, formerly professor in a Belgian college, now honorary professor of chemical engineering at Columbia University.

Working with intense concentration toward the solution of problems that had baffled all other experimenters, he created something that never existed before. And when his self-allotted job was finished, he promptly put it out of his mind, leaving its commercial exploitation to others, and turning to play and hobbies with the same intense interest he gave his inventive effort.

We must turn to one of nature's great dramas to find a parallel to Doctor Baekeland's achievement. Whirling through space, our earth is continually encountering bits of cosmic rubbish which at night are revealed to us as meteorites. Of the meteorites that reach the earth, many are found to be composed of an alloy of iron and nickel. Some have contained other substances with which we are familiar, but in others have been found substances that never before have been encountered on earth, and that have been given such names as maskelynite, trouilite, and oldhamite.

Bakelite, conceived in the mind of Doctor Baekeland, may be likened to these substances. Nature had not given us its like on earth, when Doctor Baekeland set to work to create it. It is an artificial resin that can neither be melted nor dissolved, that possesses great mechanical strength, and is resistant to moisture, electricity, and steam, as well as to most acids and chemicals. These properties have made bakelite, and other widely used products like it, the premier insulation for wireless com-

© U. & U.

Dr. Leo H. Baekeland

Who Will Free Hoarded Energy of Light?

FASCINATING possibilities of future wealth—visions of new wonders of creative science—open up as we listen to the words of Dr. Leo. H. Baekeland, the chemist whose two greatest creations—velox and bakelite—are known to millions of Americans.

"The forces of nature," Doctor Baekeland says, "are the most enduring wealth of mankind. Because science has taught him nature's laws and how to apply them, a puny little being of from about 130 to 200 pounds of flesh and bone—three fourths of which is water—has become a giant unequalled in Gulliver's travels."

And what are the still undiscovered secrets among the powers of nature? Doctor Baekeland answers: "Our annual crop of plants containing starch or sugar could supply us with an abundance of liquid fuel. We may look at this possible new source of power as simply the stored up energy of the sun. The chemical action of the sun's rays that we call photochemical action, under the influence of the green matter in plant leaves, brings about the most subtle chemical changes.

"Without this plant reaction under the influence of light there would be no crops, and upon it the whole living world depends. Our vast coal beds, our petroleum wells and our natural gas are merely light energy stored in plant or animal life of former geological periods and preserved to us. This in itself ought to impress us with the enormous possibilities of photochemical synthesis, or the forming of complex substances by the combination of simpler substances under the influences of light. AND YET HERE IS A FIELD WHERE THE SCIENTIST AND ENGINEER HAVE ACCOMPLISHED NEXT TO NOTHING. In the utilization of this marvelous energy we have not gone much beyond the art of making photographs.

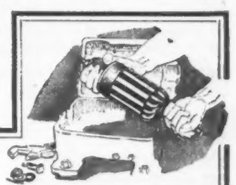
Neglected by Scientists

"So here is a power, an energy, which has been neglected by scientist and engineer alike. Who will show us how to use it? Who will teach us how to emulate nature in her creative use of the sun's rays? Who will discover how to utilize this delicate method of securing new riches and power for mankind?"

What a vast opportunity is open here for the persevering scientist or inventor!

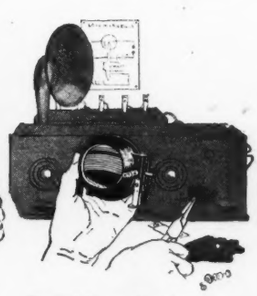
Varied Every-Day Uses of Bakelite

Covers for electrical instruments

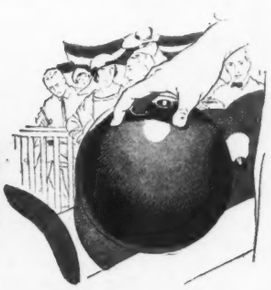


Armatures for electric motors

Transparent, amber-like pipe stems



Durable radio instruments

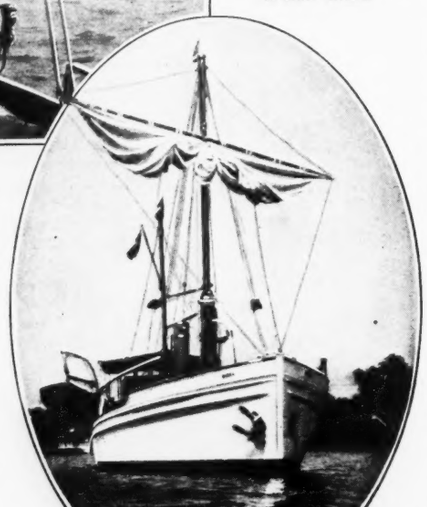


Tough, unwarpable bowling balls

Radiator caps for automobiles

Telephone transmitters and receivers

For recreation after intense experimental work in his laboratory, Doctor Baekeland turns to yachting, his favorite hobby. His unusual craft, shown below, is rigged like a brigantine, with large forward square sail into which a fore and aft sail spills a fair wind



munication. To millions of users of radio receiving sets, these products are now familiar, and hence the story of the original invention has assumed increased popular interest.

"My friends have asked me how I happened to strike such an interesting subject as this synthetic resin to work upon," says Doctor Baekeland, "and I can answer that I did not strike it in any haphazard way. I looked for just such a subject for a number of years, until I found it among the many lines of research I undertook in my laboratory."

Achievement, Not Wealth, His Object

While working on his problem, Doctor Baekeland rarely spent an entire night in bed. Often he rose at two or four in the morning to make notes—a habit of his. And it was for sheer achievement, rather than for wealth, that he worked in this way. "One of the saddest things is that money should ever be regarded as the measure of success," he says. "I could have made twenty or thirty times as much money as I have, had that been my ambition. Any fool can get rich at the sacrifice of his self respect and rest. Don't select a profession just to become rich—be a bootlegger, if wealth is your aim. But whatever you do, be the thing you love to be. If we made football a compulsory part of the curriculum at Columbia, the students would sue us for cruelty."

A tall, sunbrowned man with a jovial countenance lighted by hazel eyes, Doctor Baekeland impresses you as a retired American business man with a few healthful hobbies, rather than as a Belgian scientist. His talk is of yachting, of books, of politics, rather than of science. And it is in yachting—almost as much as in his beloved chemistry—that his heart lies.

"My boat," says he, "is a 24-ton brigantine-rigged, auxiliary powered yacht. She was a ladylike cruiser when I got her, but she had the splendid hull of a schooner. When I put in for the night, people comment on her strange rig. The square sail forward, and the fore and aft sail spilling the wind into it, are not often seen. Some of my friends, of course, cannot understand why I make only four or six knots, when I can make nine and a half. But the cruising yachtsman must be an artist, a lover of nature, and an adventurer."

So much for his hobby. Now as to his life and work.

Leo Baekeland was born in the Flemish city of Ghent, where he received his early education. Later, he graduated from the University of Ghent, where eventually he became an associate professor.

Meanwhile Baekeland had been awarded a chemistry prize that included a traveling scholarship, enabling him to visit universities in England, Germany, Scotland, and finally in the United States, a country which he learned to love and to which he eventually returned.

Ghent had been the center of the new industry of dry-plate manufacturing. Baekeland had interested himself in this industry and was a competent amateur photographer. So it was that within four years after his arrival in the United States in 1889, he founded a chemical company for the manufacture and development of his colloidal silver chlorid photographic paper—velox—which was so attractive to the Eastman Kodak Company as a commercial proposition that they bought his rights.

That success was but a start for Baekeland. He then turned his attention to electrochemistry. Soon he was selected by Elon T. Hooker to direct the work preliminary to industrial development of the now famous Townsend cell for producing soda and chlorin from salt. This work finally led to the erection at Niagara Falls of one of the largest electrochemical plants in the world, with which Doctor Baekeland is still connected in an advisory capacity.

A Search for the Answer

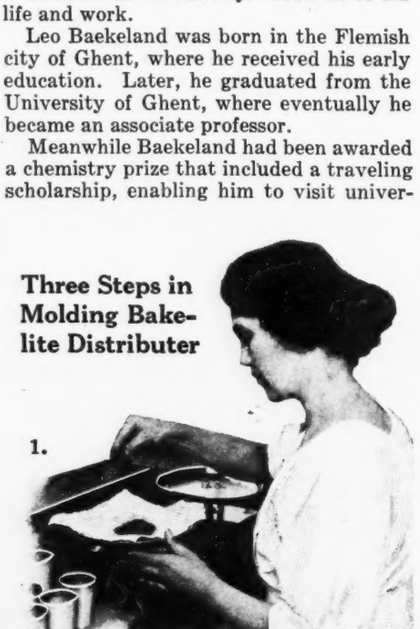
In his laboratory work Doctor Baekeland was impressed by the abruptness with which reactions always terminated after formaldehyde and phenol (carbolic acid) were mixed. Under certain conditions the mixture produced a resin that was apparently insoluble. It occurred to him that if he could find a solvent for the worthless resin, he might produce a varnish superior to any that had been produced. This supposition proved impracticable, but led him to Bakelite.

Doctor Baekeland found that when equal parts of phenol and formaldehyde were mixed and warmed in the presence of an alkali that combined the substances without itself being absorbed, the solution separated into two layers—the upper being a watery substance and the lower a resinous substance. The resin was soft, pliable, and soluble in alcohol. But if heated under pressure it was hard, inelastic, and insoluble. This was bakelite—the answer to the problem which had been thought hopeless.

"The two stages in the preparation of bakelite are convenient in many ways," says Edwin E. Slosson in his book on creative chemistry. "For instance, porous wood may be soaked in the soft resin and then by heat and pressure this resin is changed into the bakelite form, the wood coming out with a hard finish that may be given a lacquer polish. Paper, cardboard, cloth, wood pulp, sawdust, asbestos, and the like may be impregnated with the material, producing tough and hard substances. When forced, in powder or sheet form, into molds under pressure of from 1200 to 2000 pounds to the square inch, the resin is capable of being made into a hundred various objects."

Three Steps in Molding Bakelite Distributer

1.



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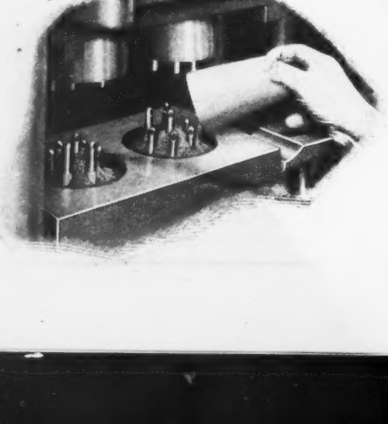

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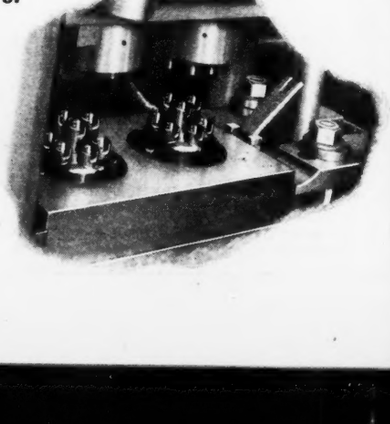
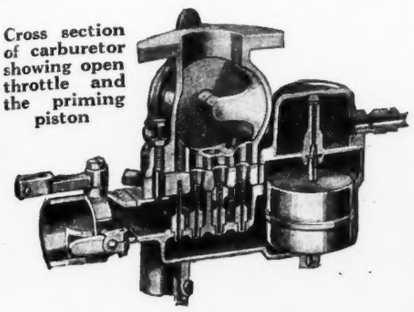


THESE three photographs reveal how a bakelite distributer for the usual automobile ignition system is made in three simple steps. Above: Bakelite powder is weighed in desired quantities. At left: The powdered bakelite is poured into molds and subjected to pressure of from 1200 to 2000 pounds to the square inch. At right: The completed distributer, showing how the powder is transformed by heat and pressure into hard insulating material, taking impressions of the mold

A Dozen Carburetors in One for the Auto

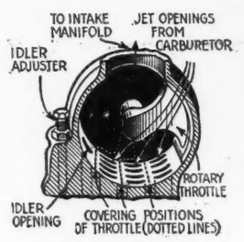
PERFECT vaporization and exact proportioning of gasoline and air are claimed for a new carburetor that is equipped with from seven to 13 gasoline



Cross section of carburetor showing open throttle and the priming piston

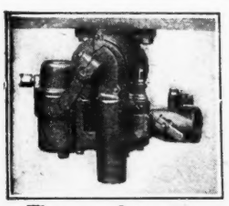
jets, including an idling jet, the number depending on the size of the carburetor.

Each of the jets is located in a well, one end of which is uncovered by the movement of the rotary throttle. In the 13-jet carburetor, when the throttle is closed, only the idling jet is exposed to the suction of the engine; but as the throttle is opened, four more jet wells are uncovered gradually and come into action.



How rotary throttle opens jet wells

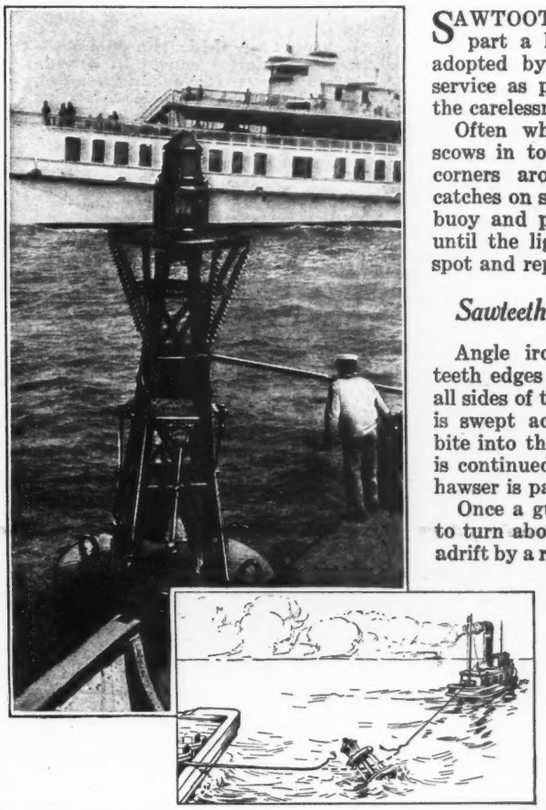
When the throttle is opened still further, four more are uncovered, and finally when the throttle is wide open, all 12 jets are in action in addition to the idling jet.



The complete carburetor, attached to car

An auxiliary piston controlled by the throttle lever comes into action only when the throttle is opened suddenly to its full extent and forces a preliminary stream of vapor from each jet. This supply of gas primes the engine and produces a quick and smooth pick-up.

Saws Protect Buoys from Tug Hawsers



SAWTOOTH fins, sharp enough to part a heavy hawser, have been adopted by Uncle Sam's lighthouse service as protection for buoys from the carelessness of tugboat owners.

Often when tugs with strings of scows in tow attempt to turn sharp corners around buoys, the towline catches on some projecting part of the buoy and puts it out of commission until the light tenders can reach the spot and repair the buoy.

Sawteeth Will Ruin Hawsers

Angle irons with sharpened sawteeth edges have now been placed on all sides of the buoys. When a hawser is swept across the buoy, the teeth bite into the strands. If this cutting is continued for many seconds, the hawser is parted.

Once a guilty pilot has been forced to turn about and pick up a tow cast adrift by a riven hawser, the lighthouse service believes that buoys armed with the protective fins will thereafter be given a wide berth.

When a towing hawser fouls the buoy, saw teeth placed near the top of the buoy, as shown in the photograph, cut the cable

Plants Serve to Locate Deposits of Ore

THAT the location of ore deposits is often indicated by the variety of plants growing on the surface above them was a recent interesting statement of E. Lidgely before the Australian Mining Institute.

A plant belonging to the poison sumach family indicates the presence of lead ore in Missouri, he said, while in certain parts of Europe the calamine violet is a sign of the existence of zinc ore in the neighborhood. A species of bindweed, in Spain, is considered a certain sign of underlying deposits of phosphate. Beech trees, Lidgely declared, often indicate that limestone beds are to be found in the neighborhood.

Thirteen-Room Doll House Is Eight Feet High

IN COLLEGE VIEW, Neb., Leo Empfield's five-year-old daughter, Virginia, plays with her dolls in a miniature two-story house, eight feet square, which her carpenter-daddy has made with all the complete detail of a "grown-up" dwelling.

It is a 13-room house, with seven rooms on the first floor, framed like any other dwelling, and clapboarded outside. Inside it is "plastered" with gray canvas over half-inch laths.

Between floors is an open winding stairway. The rooms are partitioned just as in a real house. All the windows are framed, and have glass sashes.

Mr. Empfield built the house during spare hours, in about three weeks. The material cost him about $25. A family of nine dolls now occupies the cottage.

How to Manufacture Pure Ice at Home

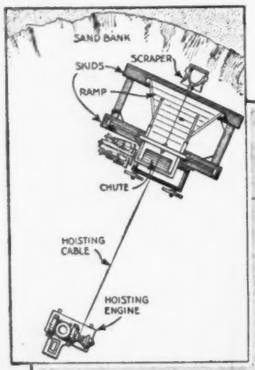
ARTIFICIAL ice may be made at home in the winter by the use of a long sheet metal box now on the market, which opens at the top and is divided into several sections. Water is pumped into each section and frozen. The forms are slightly tapered to facilitate removal of the frozen cakes.

Ice cakes molded in partitioned sheet metal box

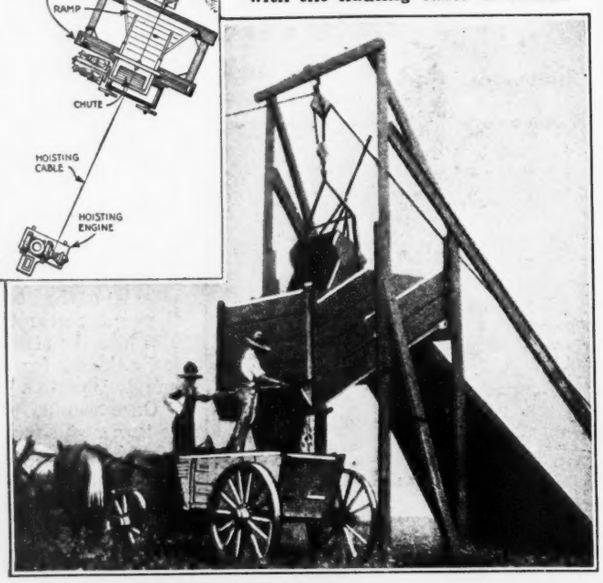
Excavator on Skids Travels in Circle

DIFFICULTIES in moving excavating machinery have been reduced to a minimum by a new combination digging and dumping device that moves on skids, describing a circle about its driving engine.

The device consists of scaffolding supporting a ramp on one side and a chute on the other. A crossbeam at the top holds a pulley for the cable from the engine. This cable draws the excavating shovel to a dumping position above the chute.



Mounted on skids, the entire excavating device moves in a wide circle about its driving engine, with the hauling cable as radius



Radium Rays Put Color and Value into Gems

RADIUM rays will change yellowish diamonds of small value into emerald-tinted gems through a process, discovered by the United States Bureau of Mines, which may make the most beautiful diamonds comparatively inexpensive. The acquired luster is permanent, resisting the most powerful acids.

Rays from a container of radium, directed upward, are focused at a small hole in a lead block. Over this hole the diamond to be colored rests in a vacuum upon a thin sheet of aluminum. The exposure is continued, sometimes as long as 16 months, until the color of the gem changes from yellow to green.

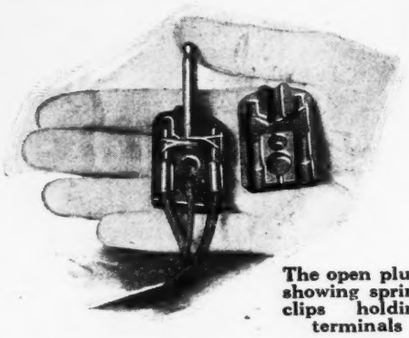
Cut sapphires have been colored a bright, canary yellow by the same method. Even colorless rock salt can be colored a golden yellow hue, which is destroyed either by exposure to direct sunlight or heat.

A scientist of national repute is now making X-ray spectrographs of colored rock salt to determine whether any change in the position of the atoms is produced by the radiation.

Phone Plug Spring Clips Make Easy Hook-Ups

EQUIPPED with spring clips that hold the terminals of a telephone cord so firmly that perfect electrical connection is obtained without soldering, a plug recently invented comes as a boon to the wireless operator in making experimental hook-ups.

In the spring leaves are holes into which the terminals are forced. The spring action, tending to force these holes out of line, produces a grip on the terminals.



The open plug, showing spring clips holding terminals

New Bandsaw Has Many Uses in Pattern Shop

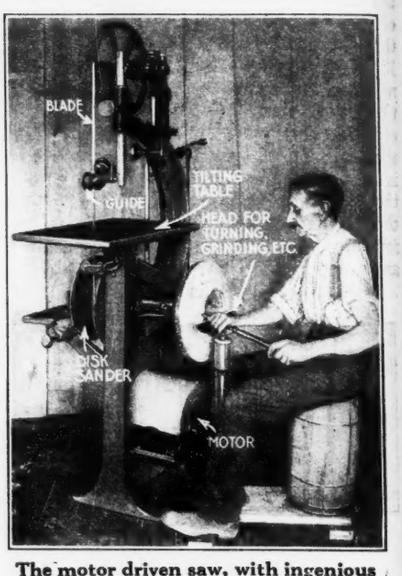
A BANDSAW invented by W. W. Paddock after 25 years' experience at the bench, has attachments that make it a complete tool for the pattern shop. In addition to bandsawing at many angles, the attachments provide for disk sanding, roll sanding, wood boring and turning, emery grinding, and wire or cotton buffing.

How Angles Are Obtained

The saw is motor driven. Ball bearings reduce the amount of power required to one-half horsepower. The saw table can be tilted on either side of an arc that is graduated in degrees each way from the table level. The limits are, forward, 45 degrees, right-handed, 45 degrees, and down, left-handed, 30 degrees.

The motor belt and the saw are on the same pulley casting, the saw pulling up and the belt down, relieving the bearing of tension.

The bandsaw itself is guided between three ball-bearing wheels, one on each side of the roots of the saw teeth, and one a V-grooved wheel at the back. This forms a frictionless guide, as all wheels turn with the saw. Below the table is a V-grooved wheel similar to the upper one. A safety fiber wheel is placed a quarter of an inch in front of the saw, preventing it from being pulled forward off the band wheels.

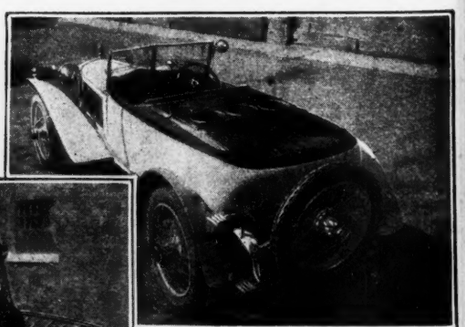


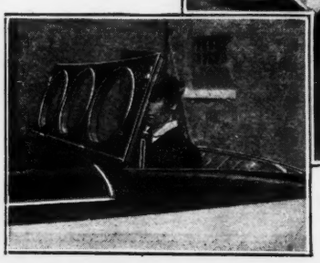
The motor driven saw, with ingenious attachments for performing a variety of work

Novel Windshield for Disappearing Seat

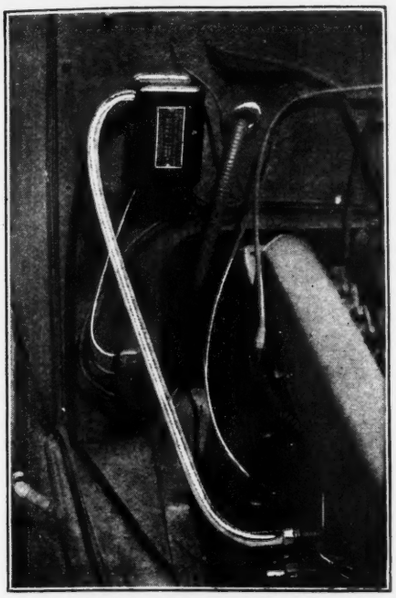
THE problem of providing a suitable windshield for disappearing seats in the rear of an automobile has been solved in an ingenious manner by an English manufacturer. The forward portion of the rear deck contains three glass covered portholes, while the rear portion tips down to form the back of the seat. (See illustrations at right.)

When the unique windshield is tipped forward into place, it is held rigid by collapsible braces.



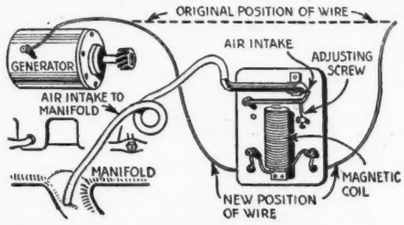


Circular windows in the disappearing rear deck, when raised, form a windshield for the passengers



Auto Generator and Magnet Control Intake Mixture

AUTOMATIC control of the air that should be mixed with fuel to produce maximum efficiency for the automobile motor is achieved by an ingenious magnetic coil device attached to the generator of the car, and containing an air intake that leads through a pipe to the intake manifold.



Magnetic coil, connected with generator and manifold, controls air supply

The air intake is regulated by a valve attached to the magnet armature that works against an adjustable spring.

When the engine speeds up, the generator increases the power of the magnet, opens the valve, and admits more air into the intake. Similarly the valve closes as the motor slows down. This apparatus, it is claimed, will increase gasoline mileage from 30 to 90 per cent.

Spiral Chimney Deflects High Winds

ONE novel solution of the engineering problem of building tall chimneys to withstand the tremendous pressure of winds at high velocity, has been offered by a British airplane engineer who has designed a strange spiral chimney in such a way that it presents a corner to winds from any direction.

Each brick at the corners is displaced one sixteenth of an inch, so that the chimney forms a spiral. As a result, each corner at the top of the stack is directly above the middle of one side of the base. Thus, the thrust of a wind is distributed over two sides of the chimney, instead of being concentrated on one side, and thin walls will withstand a wind pressure that might demolish the chimney if the sides were flat. A spiral chimney can be built without added expense.

Wind pressure is distributed on two sides of this strange chimney

Recent observations in the Gulf of Mexico have shown that wind velocities of from 120 to 140 miles an hour give pressures of from 77 to 98 pounds a square foot. These velocity records indicate that a chimney built according to the usual rule of 30 to 50 pounds to the square foot might be inadequate in localities where extreme wind velocities may be expected, or in case the chimney is built to an extraordinary height. In the case of a 60-foot chimney at the Tacoma Smelter, Tacoma, Wash., the unit of pressure adopted in construction was based on a velocity of 125 miles an hour.

Wind Power

Experience has proved that wind pressure at high altitudes is much greater than it is nearer the earth's surface, and also that on small areas there may be a pressure several times as great as the average pressure on large areas.

Press Button for a Smoke

A NOVEL cigarette case, recently marketed, requires merely thumb pressure on a button to extract a cigarette. A spring mechanism pushes a cigarette through an opening at one corner of the case. The next cigarette is pushed into position for ejection, like a cartridge in the chamber of a rifle.

How to Carry a Heavy Deer

The hunter's arms are left free to balance the load

CARRYING a deer into camp is no snap, especially if the animal weighs 150 pounds or more and the hunter has bagged his game far from the trail, as many a hunter knows to his cost.

The scientific and easiest way to carry a 150-pound deer is to join the fore feet and hind feet together by inserting the hooves of the fore feet through the tendons of the hind feet.

By fitting himself into the "harness" thus formed by the deer's legs, the hunter can adjust the full weight on his shoulders, while his arms are free to assist in balancing the load as necessity demands.

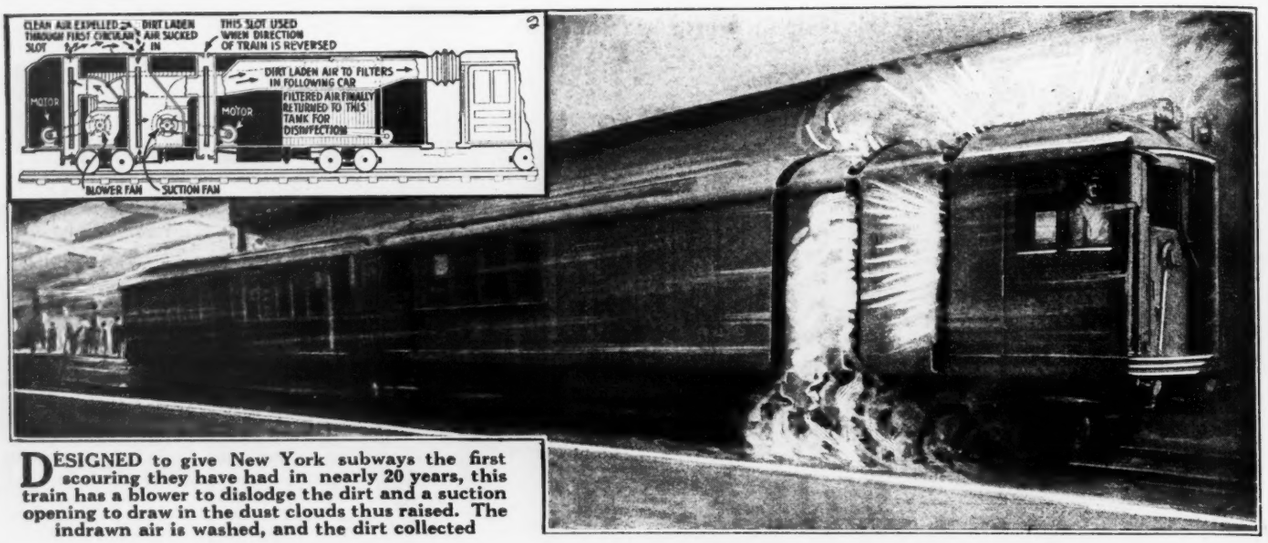
Plane and Boat Combined in Speedy Craft

With under body broad and flat, this plane-boat skims the water lightly, driven by an air propeller

SIXTY-THREE miles an hour over water is the record of a "hydroairoscepte" recently invented by a Frenchman. The best points of hydroplane and airplane have been combined in the strange appearing craft.

The under body of the water plane is broad and flat, flaring out at the sides to thin edges. This design provides the maximum lifting power and tends to lift the boat from the water. The horizontal rudder on the tail provides a certain amount of lifting surface that lessens the weight of the body on the water's surface. A 300-horsepower airplane motor driving a propeller supplies power.

"Cyclone Cleaner" to Devour Dirt of Subways


CLEAN AIR EXPELLED THROUGH FIRST CIRCULAR SLOT
DIRT LADEN AIR SUCKED IN
THIS SLOT USED WHEN DIRECTION OF TRAIN IS REVERSED
DIRT LADEN AIR TO FILTERS IN FOLLOWING CAR
FILTERED AIR FINALLY RETURNED TO THIS TANK FOR DISINFECTION
MOTOR
MOTOR
BLOWER FAN
SUCTION FAN

DESIGNED to give New York subways the first scouring they have had in nearly 20 years, this train has a blower to dislodge the dirt and a suction opening to draw in the dust clouds thus raised. The indrawn air is washed, and the dirt collected

Six-Cylinder Auto Engine "Furnace" Heats Twelve Rooms

By Robert E. Martin

BECAUSE the average gasoline engine delivers but 30 per cent of the fuel energy in the form of power and the remaining 70 per cent as heat, F. M. Miner and G. P. Miner, Jr., of Madison, Wis., figured that it should be useful as a substitute for the usual coal-fed hot water heating furnace with its heat efficiency of only 15 per cent. They tried out the idea in the 12-room house of Cyril E. Marks, near Madison, and in the first month claim to have effected a fuel saving of nearly $40, while maintaining the temperature of all the rooms at 70 degrees.

Engine Uses City Gas

The unique heating system consists of a six-cylinder automobile engine equipped to utilize illuminating gas from the city mains, and a special hot water boiler set above the engine. Circulated in the water jacket of the engine, the water, heated by combustion in the engine, rises to the boiler. The explosions are timed to occur at the top of the piston strokes. This decreases the amount of fuel consumed and reduces the speed at which the engine revolves.

The temperature of the water for the heating system is increased also by the hot engine exhaust gases which are piped through a coil in the boiler. After the hot gases have traversed the length of pipe, they have given most of their heat in useful work.

Regulation of heat is entirely automatic in the new system. When the temperature of the house drops below 70 degrees, the point at which the thermostat is usually set, a mechanical device in the furnace room, instead of opening a draft or closing a check, closes two electric circuits. One of these rotates the starting motor of the engine, while the other switches on the ignition.

At the first explosion of the engine the starter is turned off by a governor built into the engine flywheel and operated by centrifugal force. When the first explosion occurs, the speed of the flywheel increases rapidly and the connecting wheel of the governor speeds up, throwing two small revolving weights farther apart. This breaks the contact and the starting motor stops. If the engine should balk after the first cough, the starter would come into action and again turn the engine.

Twelve-room house of Cyril E. Marks, near Madison, Wis., heated comfortably by remarkable "auto engine" furnace

The part of the thermostat containing thermometer and regulator is located toward the front of the first floor in the Marks home. As the water slowly cools in the hot-water radiators, and the temperature of the room drops below 70 degrees, the thermostat starts the heating plant.

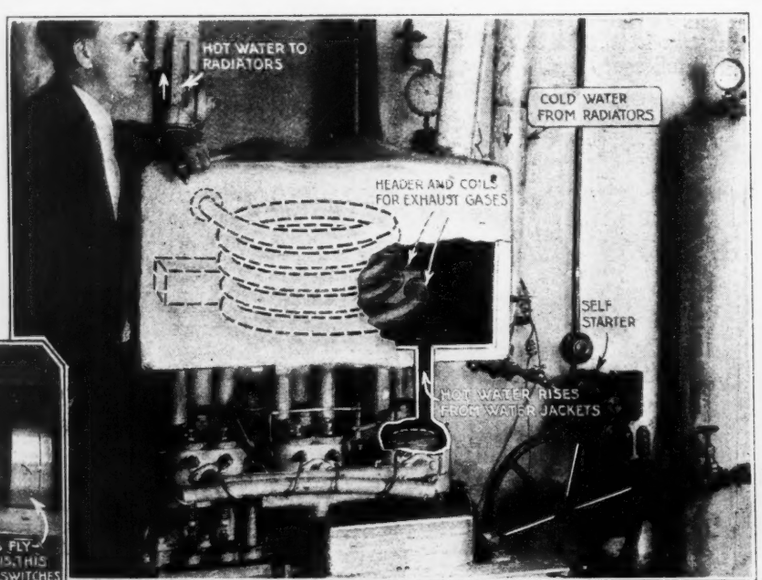
Requires Little Watching

The engine operates noiselessly and without vibration. The only attention required is the infrequent filling of the lubricating system. Once adjusted for any temperature, the heater operates for weeks without requiring attention.

The floor space occupied by the engine bed is only three by four feet. With the 60-gallon boiler, the height of the apparatus is only 60 inches.

AS ROOM TEMPERATURE FALLS, THERMOSTAT SWITCHES ON STARTING MOTOR
AS SOON AS FLY-WHEEL TURNS, THIS GOVERNOR SWITCHES OFF STARTING MOTOR

Below: Ingenious mechanism for automatic heat control. A thermostat starts the engine whenever the house temperature falls below 70 degrees


HOT WATER TO RADIATORS
COLD WATER FROM RADIATORS
HEADER AND COIL FOR EXHAUST GASES
SELF STARTER
HOT WATER RISES FROM WATER JACKETS

Above: The novel hot-water heating plant, showing how the water in boiler coils placed above a six-cylinder auto engine is heated by exhaust gases from the engine

Rescued from Desert Chasm by a Bag of Rocks!

How a Makeshift Elevator Saved Injured Motorcyclist from Death Trap

By John Edwin Hogg

WHAT would you do if you found yourself, an injured companion, and a motorcycle, trapped in the bottom of a roasting desert cauldron, with cliffs towering 75 feet above you, and with the sun beating down upon you at 125 degrees?

That was the harrowing situation from which, during a recent hunting expedition into the Panamint Desert of California, I finally managed to free myself and comrade by the application of a simple mechanical principle.

Hunting for Wild Asses

My companion in the trip was Jack Fletcher, an automobile dealer of Los Angeles. Carrying provisions for a five-day trip, we journeyed into the desert, to the west of Death Valley, to investigate reports of great herds of wild asses said to have descended from domestic animals abandoned by prospectors.

Reaching a point about 100 miles from civilization, we found the wild asses we were seeking, but discovered to our dismay that we had descended into a deep, waterless earthquake fault. It was impossible to drive the motorcycle out by the route we had come down—and there was no other exit!

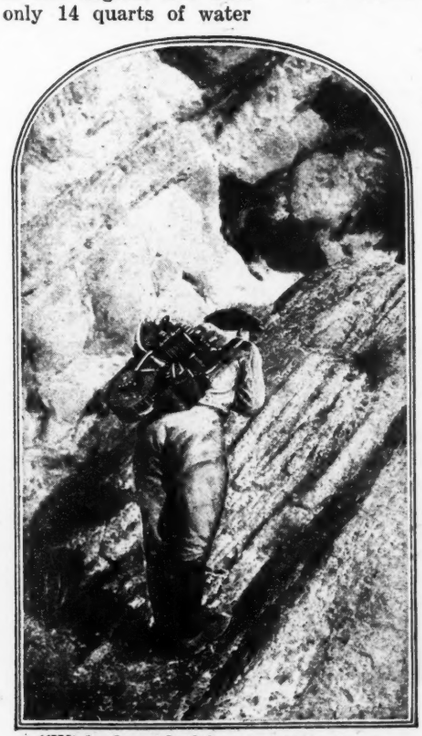
With the thermometer at 125 degrees and with only 14 quarts of water left, an attempt to get out of the desert afoot would have been suicide. The motorcycle weighed nearly half a ton and could not be moved out of the fault on its own power. So we took the motorcycle and sidecar to pieces, then dragged the parts up the face of a 75-foot cliff to the desert above. Then began the tortuous task of reassembling. Toward the end of the fourth day this exhausting work was completed. Our tormenting thirst we assuaged by chewing the watery pith of barrel cactus.

Then came the catastrophe. Fletcher, who weighs 180 pounds, while making a last dash into the gulch for supplies, fell down the 75-foot wall, seriously injuring himself. I endeavored to carry him up the face of the cliff, only to fall back utterly exhausted.

"Jack, who was huskier than I, lugged the 200-pound motorcycle frame on his back up the steep slopes of the desert trap"

It was then that it occurred to me that I might utilize the force of gravity to hoist Jack to the desert above. So I scrambled back to the summit and dragged a fallen sage tree to the edge of the cliff, allowing the trunk to protrude into the space above the chasm.

After weighting the branches and trunk with rocks, I placed a heavy tow rope over the end of the tree, lowering the end of this rope to the ledge where Jack lay helpless. Then descending, I tied the rope about his body. Returning again to the top, I tied a heavy sea bag to the other end of the rope, gradually loading the bag with heavy stones until the weight became greater than that of my companion. Soon his body, swinging clear of jagged ledges, rose to the summit.

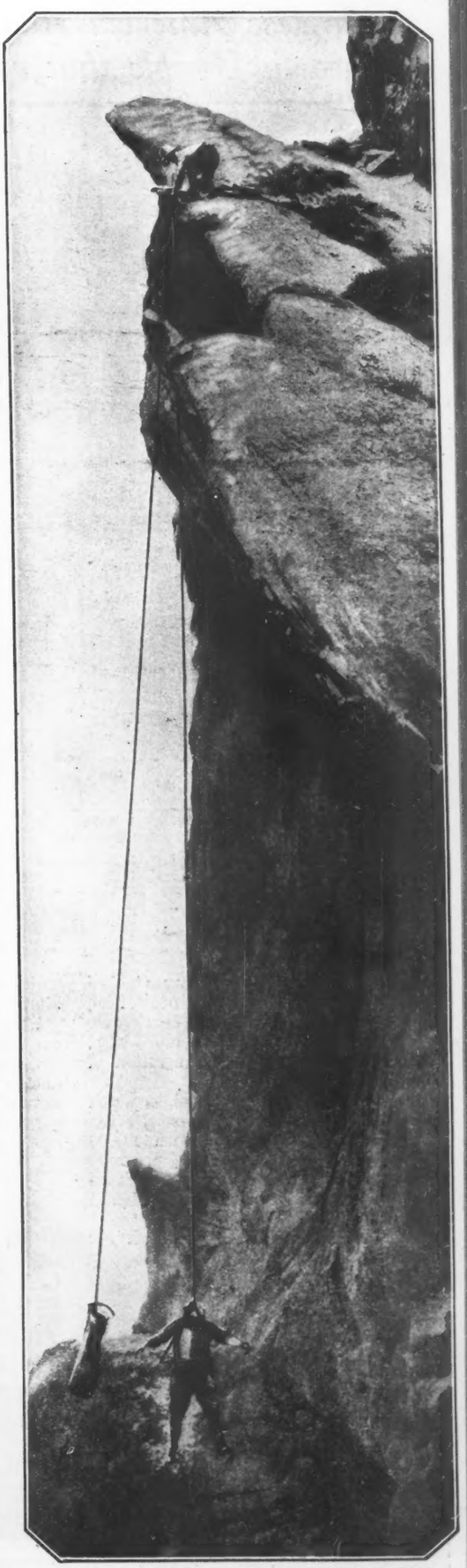


"With the aid of heavy straps, I carried the 150-pound motor like a pack sack up the cliff"

Strength Aided by Strategy

But, when Jack had reached the tree trunk, I faced the most difficult problem of all, for my strength was insufficient to swing both him and the sack of rocks toward me. The rope was not long enough to allow the bag of rocks to rest on the ledge below, so I poured gasoline down the end of the rope that held the bag and, after applying a lighted match, grasped my companion's body. Just as the rope parted, burned through, and the bag of stones dropped to the gulch below, exerting all my strength, I swung Jack safely to the ledge.

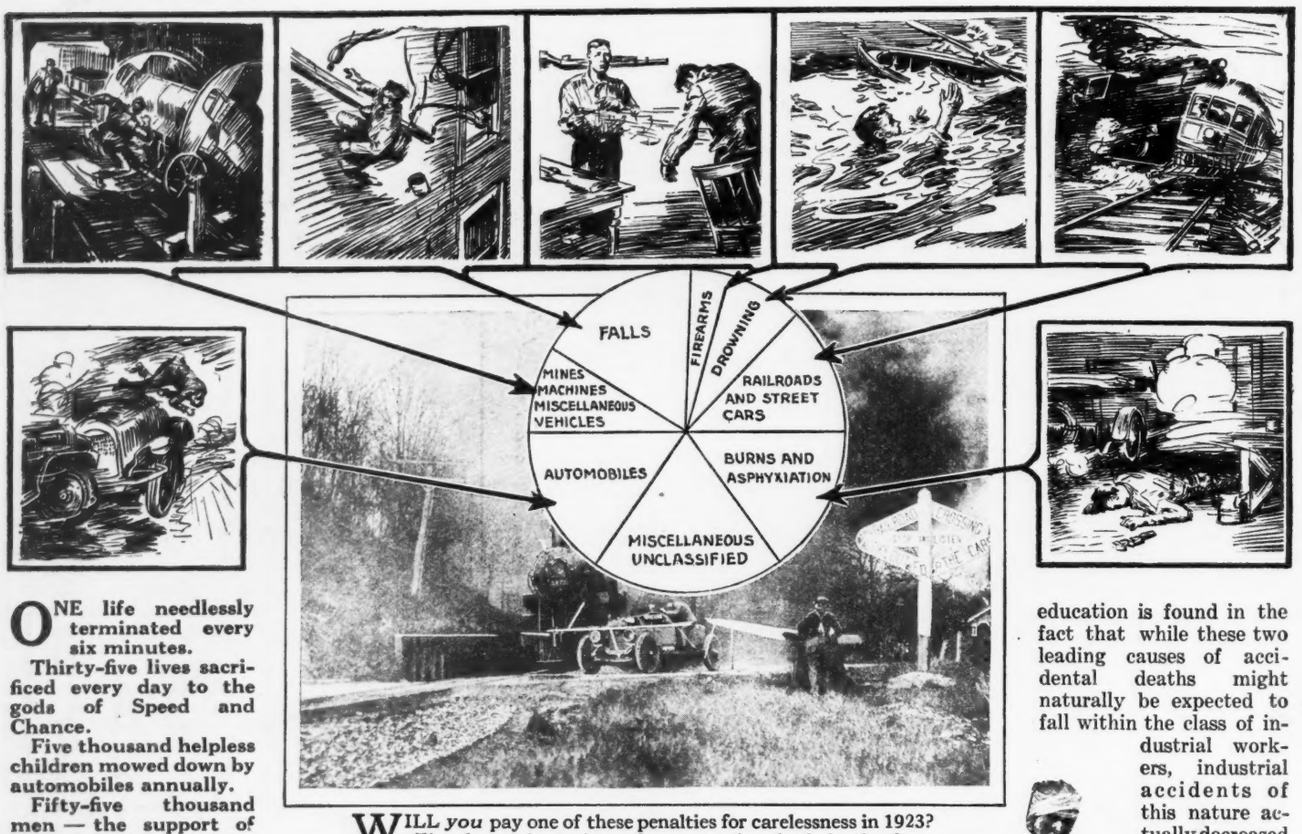
I hustled him into the motorcycle sidecar, and we began the dash homeward across the desert, to be met on the way by a rescuing party.



The writer (at top) and a newspaper man reenacting the thrilling rescue, showing how bag of rocks was used as counterweight to lift injured man

Accidents Wipe Out 75,000 Lives a Year

Careless America Allows Accidental Death Rate to Climb to nearly Double that of Great Britain—Autos Kill 35 Daily



ONE life needlessly terminated every six minutes.

Thirty-five lives sacrificed every day to the gods of Speed and Chance.

Five thousand helpless children mowed down by automobiles annually.

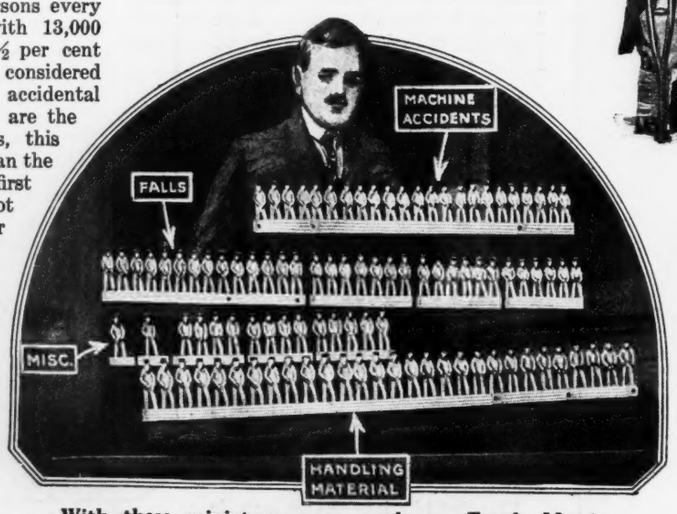
Fifty-five thousand men — the support of their families—the victims of carelessness each year.

WILL *you* pay one of these penalties for carelessness in 1923? The above chart shows how every hundred deaths from accident are divided, the automobile causing more than one fifth of all accidents. In the first eight months of 1922, eleven of every 100,000 persons were killed in automobile accidents, an increase of 8.6 per cent over the death rate for the same period of 1921—and the automobile death rate of 1921 was nearly 5½ times that of 1911!

THESE figures bring their own indictment against careless America. In 1920, 76,000 deaths from accidental causes tacked on a huge increase to our total death rate, while causing an accidental death rate almost double that in England and Wales, where there is far greater congestion of population.

The carelessly driven automobile, which stamps out the lives of 35 persons every day, is directly chargeable with 13,000 accidental deaths in 1921—a 3½ per cent increase over 1920. When it is considered that one sixth of all the accidental deaths in the United States are the result of automobile accidents, this increase is more significant than the figures might indicate at first glance—and these figures do not include non-fatal injuries. For every death by automobile accident in New York City in 1921 there were at least 25 injuries. It has been estimated that throughout the United States the proportion between injuries and fatalities is between 20 and 24 to one. This means that at least 260,000, and possibly 300,000 persons, are injured by automobiles every year. That carelessness is very largely responsible is proved by the fact that general traffic accidents (against which educational safety measures have been aimed) decreased five per cent in 1921.

Two other causes of accidents command our first attention—falling, which claimed 34 lives every day in 1921, and burning, which killed 22 persons every day. A striking commentary on the need of widespread safety education is found in the fact that while these two leading causes of accidental deaths might naturally be expected to fall within the class of industrial workers, industrial accidents of this nature actually decreased in 1921, while public accidents of the same type increased.



With these miniature paper workmen, Frank Morris, safety engineer of Boston, Mass., shows audiences of workmen that of every 100 accident victims, 33 are killed or injured by falls, 29 by negligence in handling materials, and 23 by machine accidents

Uncle Sam presents a figure of accidental maiming nearly twice as big as John Bull, for he permits 714 of each million inhabitants to be killed by accident each year, while his British cousin, by safety education, has cut his annual accidental death toll to 369 a million

The outstanding feature of accident statistics in recent years is that, although up to 1919 there was a steady decrease in the number of accidental deaths, this decrease came to a halt in 1920 and then began to climb upward. To what can this increase be attributed other than to our lack of conscience in preserving human life? How can it be remedied except by an awakening of intelligent Americans, who now stand by while 714 of every million lives are snuffed out by accidents each year, as compared with England's 369.

These Modern Baby Athletes Swim and Climb before They Talk

Science Now Debating Value of New Physical Training Methods that Produce Infant Gymnasts

By F. A. Collins

TURNING year-old babies into infant athletes has lately become a fad in this country. The story of some of these child wonders who perform astonishing gymnastic feats has set scientists asking whether a regular course of physical exercises may not be good for young babies—whether our present practice of permitting them to play idly without guidance or training is after all the best policy.

Training Two-Weeks-Old Baby

One of America's most interesting little strong men, Matthew W. Jewett, of Saranac Lake, N. Y., began his training at the age of two weeks, when his parents allowed him to pull articles small enough for his fingers to grasp, such as lead pencils and fingers. To prevent strain, no attempt was made to aid him in the grasping and pulling. Under this treatment the muscles of his hands, arms and shoulders developed so rapidly that in six weeks the baby would hold so tightly to a bar as to remain suspended in the air for an amazing time.

Even more remarkable, perhaps, was the development of Paul Bernarr Humphrey, of Philipsburg, Pa. The baby's exercise began at the age of two months, when he was put through a definite drill at six o'clock every morning. The first exercise consisted of holding him upside down, first by one leg, then by the other.

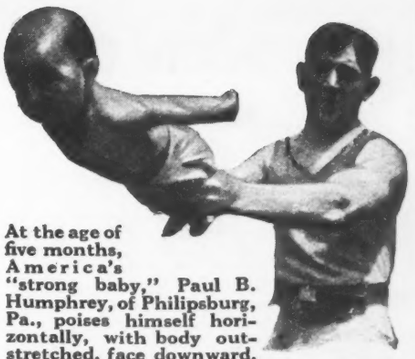
To exercise the spine and back, Paul was placed on his back, across the palm of his father's hand, so that the little body curved like an arch. At five months, the baby could hang by one arm; and when held at the knees he could support the entire weight of his outstretched body in a horizontal position, face downward.

Very similar methods of exercise were followed in the training of other baby athletes, notably Florence Froude, of San Bernardino, Calif., who at the age of six is probably America's most skilful juvenile swimmer. Just as soon as she could toddle about, she was allowed to play outdoors in the dew and cold to her heart's content. When only two years old, she began bathing outdoors, and at four she was tak ng swimming lessons.

New Exercises for Infants

Then there is Jackie Ott, of Miami, Fla., not yet five years old, whose chest expansion is 2½ inches, from 21½ inches, normal measurement, to 24 inches, expanded. His exercises, until he was given swimming instruction, consisted largely of the flexing of muscles, on principles similar to those of a new system of child training recently introduced from Germany and illustrated on this page.

Miss Virginia Stamme, junior diving champion of the Panama Canal Zone, attained her extraordinary physique training on flying rings, until she took up swimming. At five she is a remarkable athlete,



At the age of five months, America's "strong baby," Paul B. Humphrey, of Philipsburg, Pa., poises himself horizontally, with body outstretched, face downward, while his father holds his knees. Below are shown in movie strip some of his other daily gymnastic feats

"YOU'LL observe that I believe in subjecting the baby's body to rough use," writes the father of husky little Paul Humphrey, describing his baby's remarkable athletic feats, illustrated in the above photographs taken at the age of five months.

"There seems to be no limit to the health and strength to be attained by a baby through correct exercise and diet. I don't believe in fattening a baby. I aim to build pure blood and nerve energy."

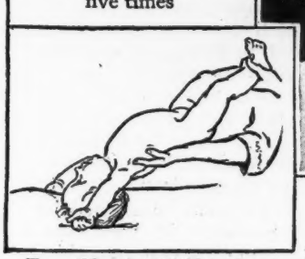
At the age of six months, baby Paul weighs 18 pounds, is 26½ inches tall, and has a chest development of 18 inches. Note that he stood erect five months earlier than does the average normal child

The New System of Baby Exercises

As recommended by the Detleff-Neumann school of physical training for children

For Neck and Chest—Child placed on stomach; feet are slowly raised until weight rests on arms. Repeat five times

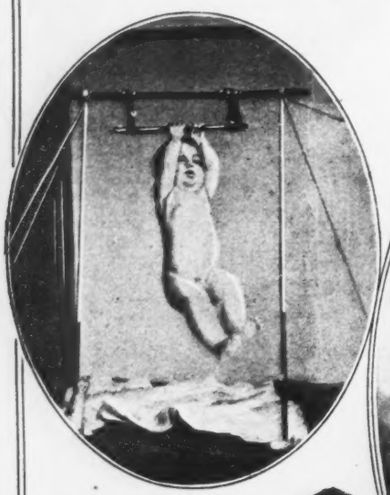
For Spine and Chest—Child placed flat on his stomach, arms stretched outward. Body is then slowly raised upward by hands, as shown. Repeated up and down five times



For Chest—Baby placed flat on back; legs raised 45 degrees; back supported. Repeated five times

For Legs—With child lying flat on his back, each leg is bent at hip and knee 10 times

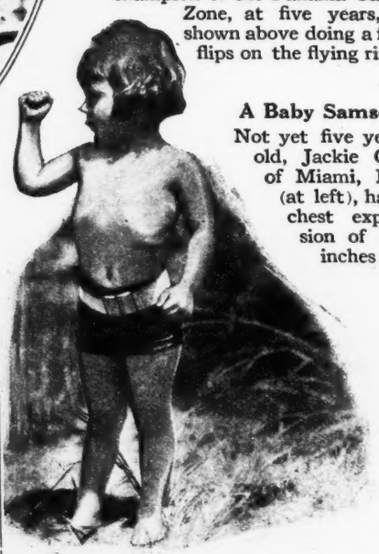
In the Gymnasium with Marvelous Baby Athletes



On the Trapeze
Matthew Jewett, of Saranac Lake, N. Y., taking his daily exercise, at five months of age, on a trapeze. He also does stunts on rings made of embroidery hoops. His parents have trained him in this manner since his seventh week

Climbs Trees at Eighteen Months
Minus clothing, Jimmy Syracuse, 18 months old, grows sturdy frolicking and climbing trees, winter and summer, in his father's private park in upper Manhattan, N. Y.

A Diving Champion at Five
Virginia Stamme, junior diving champion of the Panama Canal Zone, at five years, is shown above doing a few flips on the flying rings



A Baby Samson
Not yet five years old, Jackie Ott, of Miami, Fla. (at left), has a chest expansion of 2½ inches

Youngest Bicycle Champion
Said to be the youngest champion, Antonio Sanroma, 2½ years old, recently won a cup in a kiddies' cycle race at Madrid, Spain

Three-Year-Old Apollo
Three-year-old Lester Schnitzer, shown at left on the parallel bars, was adjudged the most perfectly developed child entered in a recent physical culture show at Madison Square Garden, N. Y.

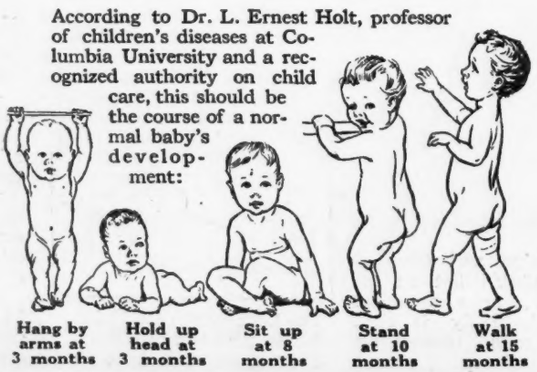
although her training did not begin as early as that of some of the others mentioned.

Equally remarkable is Rhoda Cavill, who could swim before she could walk because her father, an expert swimmer, taught her the motions when she was two. When she was three, she swam a quarter mile without pause.

Despite increasing interest in such experiments as these, many child specialists adhere to the more conservative belief that regular gymnastic exercise should be deferred until the child approaches kindergarten age—that the baby is his own best physical instructor, and should be allowed to kick and play at will, with a minimum of handling, and no regular physical training before the age of five. They argue that before this period a child cannot properly direct its muscles to carry out the required exercises with beneficial results. According to their rules, the child should be placed on a soft surface, without any clothes or wrappings to impede its movements. As it kicks, swings its arms or cries, the muscles of its legs, arms and chest will receive sufficient exercise to keep healthy.

What *Your* Child Should Do

According to Dr. L. Ernest Holt, professor of children's diseases at Columbia University and a recognized authority on child care, this should be the course of a normal baby's development:



When only a few months old, the baby should be provided with simple means for further exercising itself. A pillow should be introduced for it to climb over, and later a chair placed within reach, which will serve as a gymnastic equipment even before the baby can stand. The circulation of the body should meanwhile be developed by rubbing. When the baby begins to walk, further opportunities for exercise should be provided, but the baby or small child should, according to this school of thought, be left entirely to its own devices.

On the other hand, there has now come to us from Germany a radical new method of putting baby through gymnastic movements that are said to achieve astonishing results, not only in preserving the health and vigor of normal children, but in correcting deformities inherited from defective parents. This method, known as the "Detleff-

Neumann System of Neurode," consists of regular daily exercises for the baby's chest, neck, spine and legs.

The primary purpose of this training is not, of course, simply to develop infant athletes, but rather to lay, early in life, foundations for magnificent health in later years.

The new system of exercises is simple. Those who advocate it do so with the caution that the bones and joints of a small baby are very soft, and great care must be taken to avoid strains. The exercises are given in the open air, in summer, or in a room where there is plenty of air and warm sunshine. The body is gently rubbed, to stimulate circulation, and throughout the exercises the baby lies on a mattress of medium softness. Following are the exercises, as illustrated on page 39, each of which has a definite purpose.

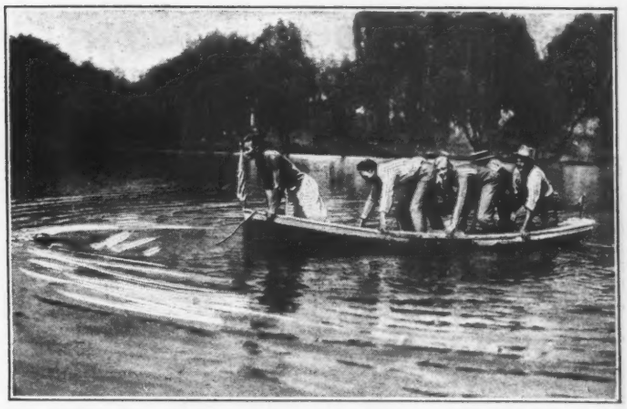
The chest is developed by laying the baby on its back and, while supporting its back with one hand, raising its feet to an angle of 45 degrees. The action is repeated slowly five times.

The neck and chest are developed by laying the baby on its face, raising the feet slowly, until the weight of the body rests on the arms. This, also, should be repeated not more than five times.

The chest and spine are exercised by placing the baby on its stomach and raising the body slowly five times, by the child's arms.

The spinal column and neck are exercised by placing the baby on its back and raising the body slowly, with the adult's hand placed in the small of the child's back.

The legs are exercised by bending the legs at hip and knee, ten times.



Six-Year-Old Swimmer Tows Loaded Boat

OUTDOOR living and swimming are responsible for the amazing physical development of little Miss Florence Froude, of San Bernardino, Calif., who at the age of 6½ years, performs almost unbelievable feats of strength in the water. With her hands cuffed behind her back, and with a rope attached to a broad belt about her waist, as shown at left, she recently towed a rowboat loaded with six men for a distance of 50 feet. The combined weight of the men was 1050 pounds!

These, with slight variations for correcting defects in abnormal children, are the complete exercises. They are repeated two or three times a day.

It is an interesting coincidence that the exercises used in developing a dozen or more of America's "infant prodigies" were simple variations of these exercises, although in some cases not all were used, or were used in a slightly different form.

Believers in this school of physical education for infants hold that the average baby thus trained will reach early childhood with the physical equipment usually enjoyed only by a few favored children, and that the proportion of school children who are narrow chested, anemic and physically unfit generally will be greatly reduced. It is important, however, that any training of babies and young children should be harmonious and continuous.

At birth, the circumference of the chest is usually about one half less that of the head. This proportion remains through early infancy. At the end of the second year the measurement of the head, chest and abdomen should be about equal. It is not until the third year that the average circumference of the chest should exceed that of the head.

Those who advocate developing babies by artificial exercise add the caution that these correct bodily proportions at various ages should be preserved.

"Don't Leave It to Nature," Advises Health Expert

Dr. Eugene Lyman Fisk

"WHAT kind of physical training should I give my child?"

Here's the answer of Dr. Eugene Lyman Fisk, medical director of the Life Extension Institute, New York City, and national authority on health subjects:

"It is important that a regular system of exercise be commenced with infants as soon as they begin to gain their muscle sense. At no time should the young bodies be swaddled up or restricted; the little limbs should be allowed all possible freedom.

"If babies are allowed to kick and roll about, following their own instincts, much good will result, but their exercise may also be intelligently directed.

"The period at which the little body should be trained varies in different cases, and therefore it is important that the exact needs of the child should be ascertained. Thus, parents should not dismiss the physician after the birth of their child, leaving its physical development to nature. A child should have a regular physical examination, say, once in every three months throughout infancy and early childhood, and an intelligent course of exercise should be prescribed by the examiner.

"The baby is, of course, a man in miniature, with some 400 different muscles forming a complicated machine. I would especially stress the importance of an intelligent system of exercise when the little body is tender and its future form is being determined.

"Care must be taken, however, to avoid abnormal development. I do not believe in developing physical monstrosities. The chest, legs or arms should not be developed out of proportion."

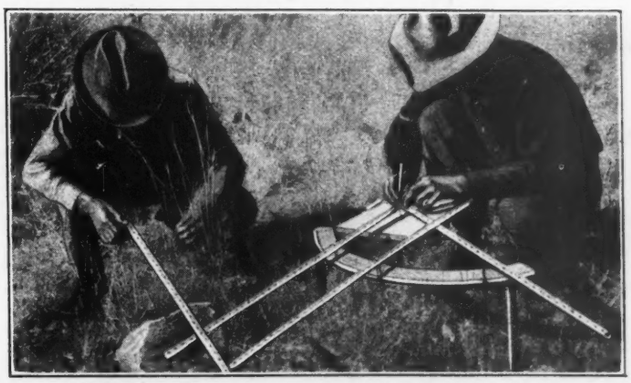
Vegetation on Grazing Lands Mapped with Pantograph

THE pantograph, an instrument employed by draftsmen for copying maps and plans on an enlarged or reduced scale, is used now by the United States Forest Service in making detailed maps to scale of vegetation on sample plots of ground a yard square.

Hundreds of these plots are laid out on the grazing lands of our national forests where 9,500,000 head of live stock are grazed each year, and are carefully studied for increase or decrease in vegetation.

Usually, the instrument is operated by two men; one moving the free moving pointer arm about the base of each bunch of grass or weeds close to the ground, the other holding the mapboard on which the area covered by the pointer arm is reproduced to scale by a pencil point. The resulting map consists of a number of irregularly shaped figures resembling in outline circles, rectangles, etc. These represent the area covered by forage plants in proportion to the plot.

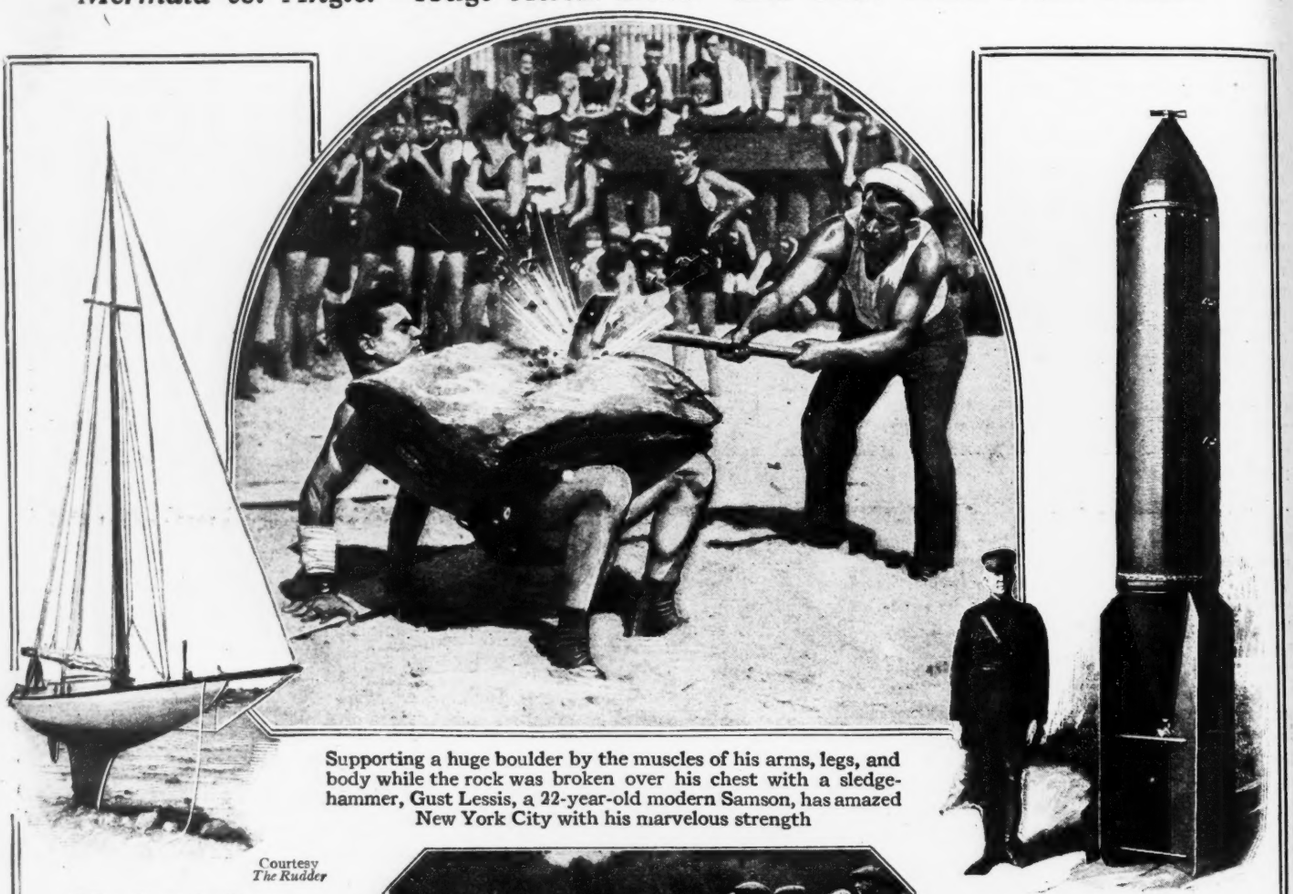
From these data it is possible to determine the percentage of increase or decrease in the vegetation on grazing land.



Rangers with pantograph "mapping" a square yard of soil

Huge Boulder Broken over Modern Samson's Chest

Mermaid vs. Angler—Huge Aerial Bomb—and Other Novel News Photos

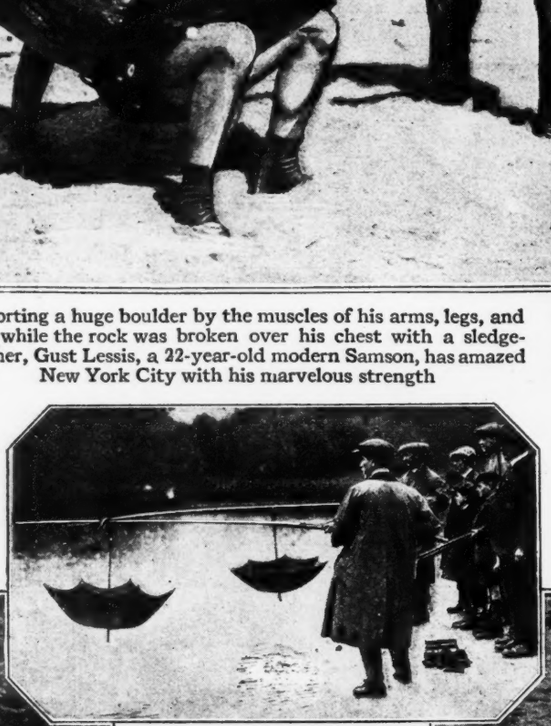


Supporting a huge boulder by the muscles of his arms, legs, and body while the rock was broken over his chest with a sledge-hammer, Gust Lessis, a 22-year-old modern Samson, has amazed New York City with his marvelous strength

Courtesy *The Rudder*

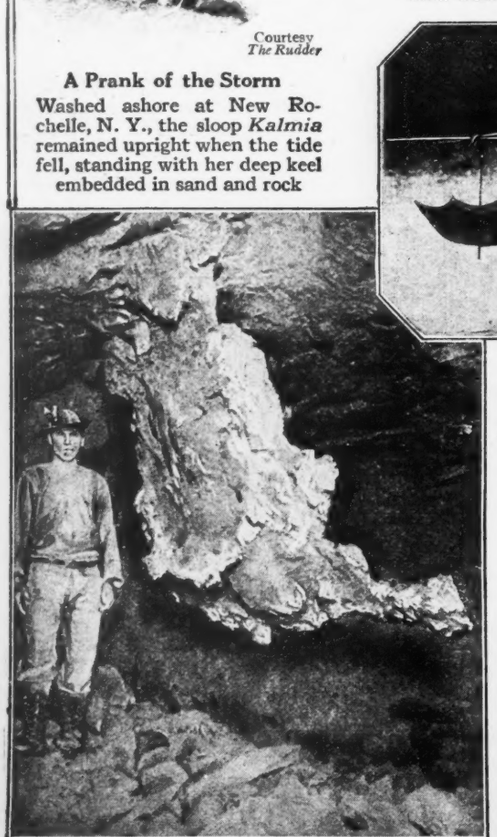
A Prank of the Storm

Washed ashore at New Rochelle, N. Y., the sloop *Kalmia* remained upright when the tide fell, standing with her deep keel embedded in sand and rock



World's Deadliest Bomb

This photograph reveals the enormous size of one of Uncle Sam's 4000-pound aerial demolition bombs



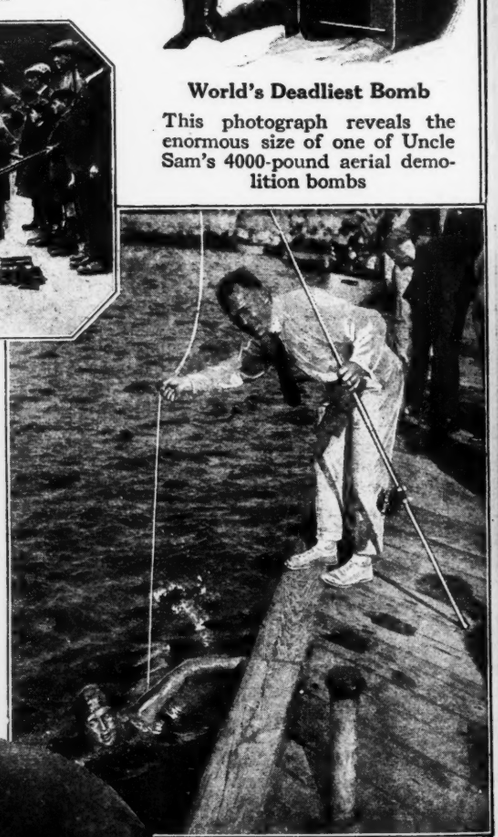
Umbrellas for Bait

Shadows cast by umbrellas have been found by English anglers to be attractive to fish. Curved handles of the opened umbrellas are hung on the rods

A 400-Pound Baby

"Teddy," shown below with his mother at the Philadelphia Zoo, is one of the few baby hippos born in captivity to survive. Age, two months. Weight 400 pounds

© Keystone



Smelted by Nature

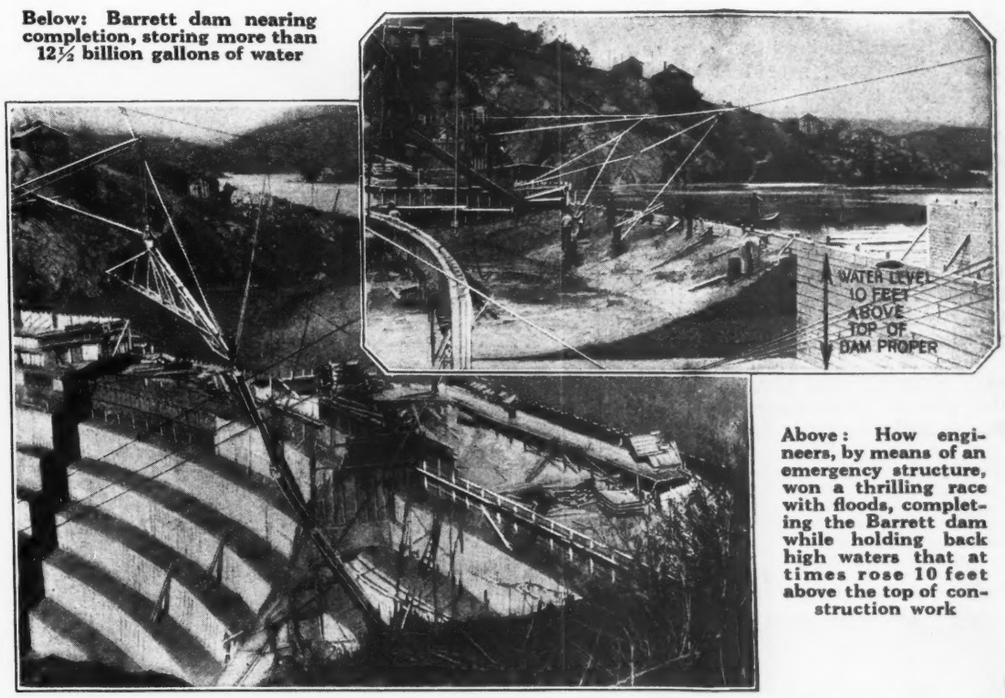
This is one of the world's largest nuggets of solid "native" copper, found in a northern Michigan mine, and possessing the purity of the smelted metal

Angler *versus* Mermaid

Here is Harold Lenz, champion caster, "hooking" Miss Ethelda Bleibtrey, champion woman swimmer, at start of thrilling mermaid-angling contest. The mermaid won

Thrilling Race with Flood Saves Cost of Dam

BY WINNING a grueling race with flood waters, engineers constructing the Barrett dam on the Cottonwood River, Calif., saved for San Diego more than two billion gallons of water, valued at $200,000 and thousands of dollars' worth of construction materials. Although the water of the reservoir was sometimes 10 feet higher than the top of the dam they were building to hold that water back, these engineers performed the remarkable feat of completing the dam without loss of water or materials.



Below: Barrett dam nearing completion, storing more than 12½ billion gallons of water

Above: How engineers, by means of an emergency structure, won a thrilling race with floods, completing the Barrett dam while holding back high waters that at times rose 10 feet above the top of construction work

A Race with Time

Construction on the dam began in the dry season and it was believed that sufficient progress had been made to hold all the water that might come during the rainy season. However, the total precipitation was more than 200 per cent of the normal—the second heaviest rainfall in 75 years—and the first run-off raised the level of the reservoir from an elevation of 50 feet to 106 feet. Soon it was seen that the water would be over the top of the incompleted structure, and immediately there began the thrilling race with time.

Concrete piers were hastily thrown out on the water side of the uncompleted dam and between the piers stop planks were placed just at the instant that water reached the top of the construction work. Thereafter the water was always from two to 10 feet above the lowest part of the top of the structure; yet the main portion of the dam was built while the water was being held back by the temporary wall.

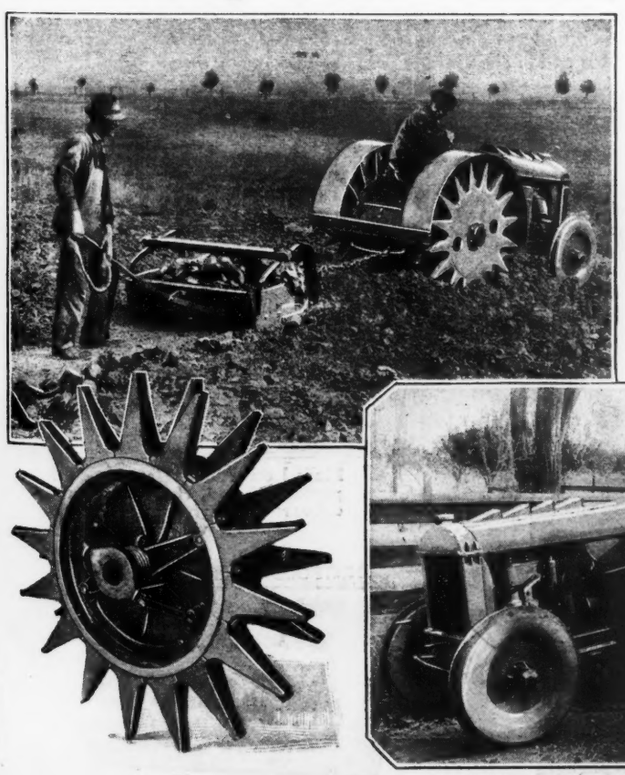
To add to the difficulty, the 14-mile road over which cement was hauled, became impassable and it was necessary to haul over a temporary route about twice as long. At one time all trucks available were mired in soft spots along the road.

Despite all these difficulties, however, the dam was completed in record time, making it possible to utilize the full storage capacity for the season's run-off, and placing San Diego in an unusually favorable position with regard to water supply.

Billions of Gallons Stored

The work required the excavation of 75,000 cubic yards of material and the placing of 140,000 cubic yards of masonry in producing a storage capacity of 12½ billion gallons of water.

"Walking" Farm Tractor Digs Its Spurs into the Ground



Wedge shaped spurs, digging into the soil, prevent this tractor from slipping or becoming mired in soft ground. For travel over paved roads, removable steel tires are placed over the spurs, as shown below. Note clutch mechanism in inset

LOSS of tractive power resulting from the slipping of tractor wheels on soft or muddy ground is almost entirely eliminated in a new "walking" tractor that literally thrusts its spurs into the ground.

The tires of the rear drive wheels, used only when the machine travels over macadamized roads, are removable, while the spokes are in the form of two rows of wedge-shaped spurs, 10 inches long, 16 spurs in a row. For travel over soft ground the tires are removed and the spurs penetrate the soil.

Staggered Spurs Prevent Jolts

Spur points are staggered so as to diminish the distance between the points of contact with the ground and thus avoid the jolting of the tractor on hard ground. On hard soil there are always 8 points in contact with the ground; on loose ground there are from 12 to 16 points in contact, with a weight on the rear wheels of more than 2000 pounds. With a penetration of six inches, the actual area available for pulling the load is 170 square inches.

Each wheel has its individual clutch mechanism which may be released independently of the other drive wheel, making it possible to turn within a radius of 13½ feet.

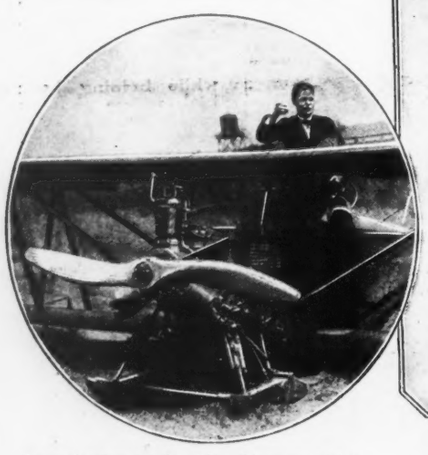
The tractor is designed to obtain the greatest possible effective power and to avoid as much as possible the raising of dust while it is in operation.

Plane Drops Wheels in Midair and Lands on Skids

INCREASED flying speed and greater safety in landing are promised with the invention of a new releasable landing gear that enables the aviator, after ridding his plane of the weight of landing wheels in midair, to effect a landing on skids. A parachute carries the wheels safely to earth.

Many planes have been wrecked because of the inability of their landing wheels to negotiate rough or swampy land on which aviators were forced to descend. Use of the skids after wheeled gearing is released, enables the aviator to make a short stop after landing on rough or swampy ground.

The chief obstacle in landing an ordinary plane on such terrain has been that the wheels have sometimes been the cause of the machine's capsizing.



Completing 50-foot landing on skids —Lawrence B. Sperry, inventor

Released in midair, the wheeled gear is carried to earth by parachute, in this manner freeing the plane of useless weight and wind resistance

The chief advantage of the novel landing gear, perfected by Lawrence B. Sperry, son of Elmer A. Sperry, inventor of the Sperry gyroscope, is that when the plane is freed of the weight and head resistance of the wheels, its climbing power and speed are increased. It will be remembered that Hawker, in his transatlantic flight, dropped his landing gear after the take-off. His machine, however, was not fitted with skids and it was necessary for him to trust to luck in finding water or a bog to land on; but he preferred to take this chance rather than carry the increased weight of landing wheels.

Plane Lands in Short Space

Demonstration of the new apparatus at Farmington, L. I., proved that with skids it is possible to make a successful landing within a much shorter space than heretofore. In several landings, the plane traveled only 50 feet along the ground before it came to a full stop. This, of course, tends to prevent crashing into fences or other obstacles when making a forced landing.

Human Eye Absorbs Metal

THAT the human eye is able to completely absorb a piece of steel or iron is claimed by Col. Harry S. Gradle of the Officers' Reserve Corps, U. S. A. He says a piece of steel flew into a worker's eye and the lens tissue became slightly discolored brown by the oxidized metal. Afterward a magnet failed to locate the metal that had been plainly visible a few months before.

The Deaf Hear through Their Bones with Vibration Amplifier

PERSONS who are "stone deaf" may now hear through their teeth, skulls, and the bones of their wrists and knuckles by using a "mechanical ear," perfected by S. G. Brown, Fellow of the Royal Society of England. His invention is based on the fact that we may feel as well as hear noises. The noise of a big explosion at a distance, for example, is felt rather than heard.

Hearing over the Telephone

The new mechanism, of course, extends no hope to persons whose deafness is the result of injury to nerves between the outer and inner ear.

The device consists of a small ebonite case fitted with an electromagnet of the horseshoe type, energized by an electric current from a battery. When a deaf person wishes to hear over the telephone, the wiring is connected with the telephone circuit by means of a small plug on the case. Between the poles of the magnet a small iron bar or vibrator is screwed to a brass block and projects through a slot ending in a curved button on the outside of the case. This button, when the device is being used, is pressed firmly against the bones of the skull or knuckles. Vibrations of sound amplified by the instrument pass through the bony structure and are received by the nerves of hearing leading to the brain. This result may be accomplished even if the whole of the outer ear be useless and unresponsive to the ordinary microphone.

As an alternative to the button, an extension piece shaped like the curved mouthpiece of a pipe is fitted to the outer end of the vibrator and held between the teeth.

Not the least remarkable feature of this instrument is the distinctness of sound impressions received.

Miss Katherine Steffens, of Detroit, "hears" through bones of her little finger placed on a telephone diaphragm

Placed on a knuckle of a deaf person's hand, the "mechanical ear" shown below, amplifies sound vibrations

How Self-Taught Lumberjack Invented the World's First Endless-Tread Logging Tractor

A. O. Lombard's Climb to Fortune an Epic of the Maine Woods

By John Walker Harrington

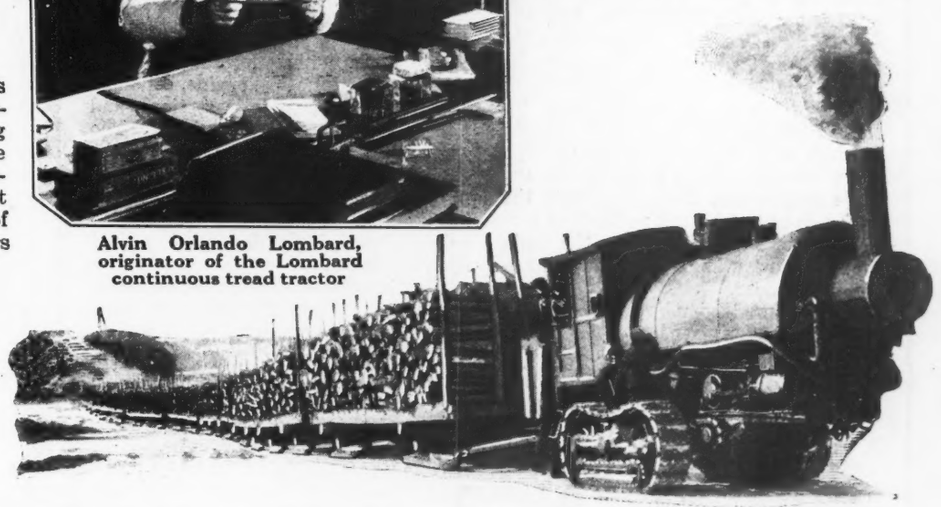
BEHIND the scenes in the story of every invention lies a romance that is often forgotten in the thrill of the achievement itself. There may have been a fierce battle with privation, a seemingly endless journey through mazes of detail and red tape, or the surprising development of an unexpected invention from a beginning that promised another outcome.

A Romance of Invention

One of these real romances of life is to be found in the story of Alvin Orlando Lombard, the onetime ax-swinging Maine woodsman and member of the "Lumber Lombard" family, who designed and put into operation the first continuous tread logging tractor, one of the granddaddies of present-day tractors and of the tanks of wartime.

We now know Lombard as a retired millionaire-inventor, creator of the continuous tread tractor, of a machine for removing the bark from logs used in paper-pulp making, of a pulpwood crusher, of a machine for separating sawdust and pine knots in sulphite mills, of an automatic device for sawing pulpwood into two-foot lengths for grinding, of a governor for controlling the speed of water turbines, and of a score of other useful appliances that are being used in industry at the present time.

Alvin Orlando Lombard, originator of the Lombard continuous tread tractor



Lombard's original continuous tread locomotive log hauler which he claims was the "granddaddy" of all modern tractors of this type, was capable of dragging sleds laden with 50 tons of logs

Less than half a century ago we should have known him as a simple, unschooled woodsman who had nothing to distinguish him from his neighbors of the north woods except his love of finding out the "why" of the crude appliances then used in cutting and hauling logs for the mills and his desire to make possible time and labor saving changes in this equipment.

Of the family of Lumber Lombards who migrated long ago from the sunny hills of Lombardy in Italy to the snow covered mountains of Maine, Alvin Lombard at eight was bunching all the shingles for his father's mill.

From the Bottom

In doing this monotonous work he mastered the secrets of advancement that have made him a successful inventor and a millionaire. At 12, Alvin was considered the most expert shingle buncher in Maine. At the age of 13, he got his first taste of the operation of machinery when he began sawing with his father's shingle-machine. In the meantime he had picked up some reading and writing and arithmetic and delved with surprising zeal into the realms of higher mathematics.

The lumberjack, as a young man, designed and built his first sawmill from "plans in his head.". While operating the mill, having had experience as a lumberjack, swamper, river driver, and sawyer, he saw the need of a regulator with which to govern the speed of the water turbine from which he obtained his power.

No one he knew had ever heard of such an appliance, so he invented one and persuaded his brother, a machinist, to build it.

The regulator was so successful that immediately a larger one was built and installed at the gate of a waterwheel used in generating power for the generating plant of a street railway in Bangor, Me.

Right there began the career of Alvin Lombard, inventor. Recognizing the value of his invention, he turned from lumbering and milling to the manufacture of governors, remaining in this business for six years and then selling his plant and devoting his time and capital to the development of other inventions already mentioned.

One of the problems that Lombard had been turning over in his mind all this time was the knottiest in the American lumber industry: "How to get out the timber." The problem had been solved in a measure by the use of logging railroads, but tracks and wheels had limitations. In Wisconsin, George Glover had tried to meet the need by designing a steam engine that carried extra steam and a special tank of hot water to be used for melting snow in front of the engine. The idea was that the snow thus melted would freeze as soon as the engine passed over it and form ice over which the logs would slide. In practice the engine failed.

Locomotive on Treads

Lombard finally solved the problem and placed on the market in 1903 what he claims was the granddaddy of all present-day tractors. He used for his purpose a steam locomotive placed on two endless chain treads, each made of plates mounted on two large wheels. "This," says Mr. Lombard, "was the first commercially workable continuous tread type machine."

(*Continued on page 46*)

"The Other Parent of Invention"

IF NECESSITY is the mother of invention, persistency is the other parent—and the remarkable mechanical achievements of two pioneer woodsmen, described on this and the next page, are vivid illustrations of the fact.

Two striking and widely used applications of motive power with which we are familiar today we owe respectively to the persistent inventive efforts of an untutored Maine woodsman and of a Michigan logger.

Between the lines of these brief sketches, telling how the endless tread steam tractor and the tremendously powerful Shay locomotive were invented, you will read the recipe for success in invention—

"First, the idea; then unconquerable grit in execution of it."

Another Inventive Lumberjack

JUST as lumbering necessities in the Maine woods forced Alvin Lombard to invent a continuous tread tractor, ancestor of the tractors we know today, so hard times drove another pioneer woodsman, Ephraim Shay, of Michigan, to devise a novel wood hauling engine, parent of the powerful vertical-cylinder "Shay locomotive," used today for pulling tremendous loads in railway yards and on steep grades.

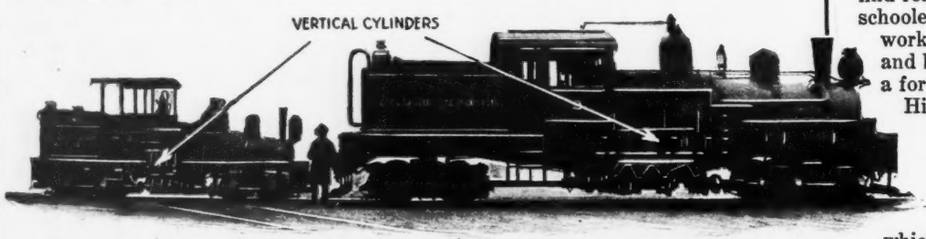
In his first efforts, back in 1870, to solve the log hauling problem, Shay tried a tramway running on maplewood rails, and drawn by horses. The horses were killed by brakeless cars going downhill. Next, he tried a light locomotive, but the drive wheels ruined his wooden rails. From this experiment, however, he gained the idea that the efficiency of a locomotive could be increased by transmitting power direct to the trucks through a shaft, instead of through drive wheels. Shay removed all the drive mechanism, then rearranged the engine so as to transmit power by a system of gears operated from the main shaft to the trucks of both the locomotive and tender.

Shay's first locomotive, was a vertical engine boiler placed on a flat car.

Shay's first locomotive, consisting of vertical engine and boiler mounted on a flat car

The modern Shay locomotive has a three-cylinder, vertical engine, driving a horizontal shaft, made in sections, and joined with flexible couplings. The shaft extends the entire length of the engine, and drives all the axles by means of bevel gears. The wheels are grouped in four-wheeled center-bearing swiveled trucks, permitting each truck to adjust itself to curves.

Shay locomotives, weighing 160 tons, now in use, climb 14 per cent grades, and negotiate curves of 50-foot radius.



Two modern truck-drive Shay locomotives weighing 10 and 60 tons respectively. Note on each locomotive the three-cylinder vertical engine and the horizontal drive shaft

(*Continued from page 45*)

The new machine revolutionized the lumber industry, proving capable of dragging sleds and wagons laden with from 40 to 50 tons of logs and plowing through snowdrifts and underbrush.

The First Lombard Gas Tractor

Lombard did not stop at that. With the vogue of the gasoline engine, he adapted it to his needs and produced the first gasoline endless tread tractor, which, curiously enough, was used first, not for the lumber industry, but for hauling from place to place a traveling moving-picture and vaudeville show. And, in order to accomplish this success, the former lumberjack had to study and master the details of the tensile strength of metals, for the tractor, to be of use, must be just as effective in the heat of summer as in the cold of the north woods.

The "surprising sawyer" has not changed much since his early days as a woodsman, despite his accomplishments. Since his retirement from active business, Lombard has been at work on new inventions on his estate at Waterville, Me., where, in his workshop, he spends much time working out models of needed inventions from "plans in his head."

A Remarkable Workshop

The inventor who complains of lack of funds, schooling, and equipment, should find real inspiration in the story of the unschooled lumberjack who looked forward, worked out revolutionizing inventions, and by his own efforts made a living and a fortune.

His secluded shop is situated beside a stream from which he draws the power to operate his machine tools, and the speed of the water-wheel that runs his dynamo is regulated by the very governor which he invented. Sometimes, for recreation, he chops down trees with all the skill that marked his undergraduate days as a lumberjack in the Maine woods.

Harnessed Mud Turtles Clean Clogged Drains in Michigan Town

MUD turtles are earning their salt! Strapped in little harnesses to which are attached long leashes, they have been put to work in the town of Hillsdale, Mich., plowing through silt and refuse that clogs long drainpipes, and saving the town about $500 a year (for which the turtles receive their board and lodging).

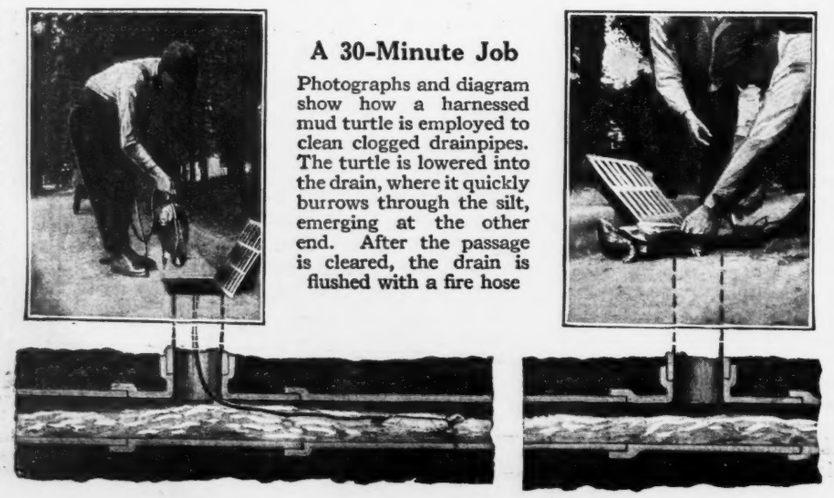
Hillsdale, like other towns, has countless drainpipes lying a couple of feet below the surface of the streets, to carry off surplus rain and melted snow into the sewers. Some of the pipes are several hundred feet long—a circumstance that is no drawback until the tiles become plugged with mud. Then the usual method of cleaning by shooting a powerful stream of water through the drain is of little avail.

Sometimes it required several days' work to clear one drain, until the superintendent in charge, with the subject of mud continually on his mind, thought of using mud turtles to clean out the caked silt!

First he caught one of the leatherbacks. Then he fastened a harness to its shell. To the harness he attached a string a trifle longer than the drainpipe to be cleaned, and to the free end of the string a piece of chain. Then he placed the turtle, head first, into the clogged drainpipe. And the turtle, who dotes on burrowing, didn't require much urging to dig into the mass of silt. If the animal stopped and rested too long, a jerk on the line started him on his way again.

Thirty minutes after the start, the turtle emerged from the other end of the 200-foot drain. The string and chain were pulled through after him, and a stream of water from a fire hose completed the cleaning that before had seemed a hopeless task.

Now, among its unlisted assets, the town owns six drain-cleaning mud turtles — trained experts that live in a special pond and eat special food—a fitting and satisfying reward for their services.



A 30-Minute Job

Photographs and diagram show how a harnessed mud turtle is employed to clean clogged drainpipes. The turtle is lowered into the drain, where it quickly burrows through the silt, emerging at the other end. After the passage is cleared, the drain is flushed with a fire hose

Novel Counterweight Bridge Opens in 90 Seconds

The bridge closed. Note how counterweight and span swing on separate axes

Counterweight swings downward, raising the span

A REMARKABLE railway bascule bridge, in which the counterweight and the bridge span swing on different axes, is now in operation across the Rouge River, where the tracks of the Pennsylvania and Wabash railroads lead into Detroit, Mich. The structure, called the "cross-rotating" type of bascule, is said to be the only one of its kind in the world. One of its extraordinary features is the motor house, which travels up and down an inclined track, following the movement of the counterweight, and which actually forms part of the weight itself.

The ordinary bascule operates simply as a lever with a counterweight to balance the bridge proper. Weight and bridge both swing on the same axis.

The counterweight of the Rouge River bridge, on the other hand, swings in a quarter circle on a pivot just beneath the apex of a tall triangular steel frame, while the bridge proper is pivoted at the base of the frame. Bridge and counterweight are connected by jointed girders.

When the bridge is down, the counterweight is suspended in a horizontal plane, where it is locked against movement by racks and cogs of the incline. When the bridge is raised, the counterweight swings downward in a half circle, while the motor house moves down the incline in front of it.

Less Power Needed

This arrangement is said to require less power for operation than the ordinary bascule and is quicker in opening and closing the bridge. A 100-horsepower electric motor opens and closes the bridge in 90 seconds.

An extra motor is provided for use in case of a breakdown. A gasoline engine that will open the bridge in eight minutes is also available.

Concrete blocks, each weighing 2500 pounds, make up the 1000-ton counterweight. The movable span is 162 feet long. In the power house is mechanism that prevents operation of the bridge until all signals are set.

Powerful Telescope Five Inches Long

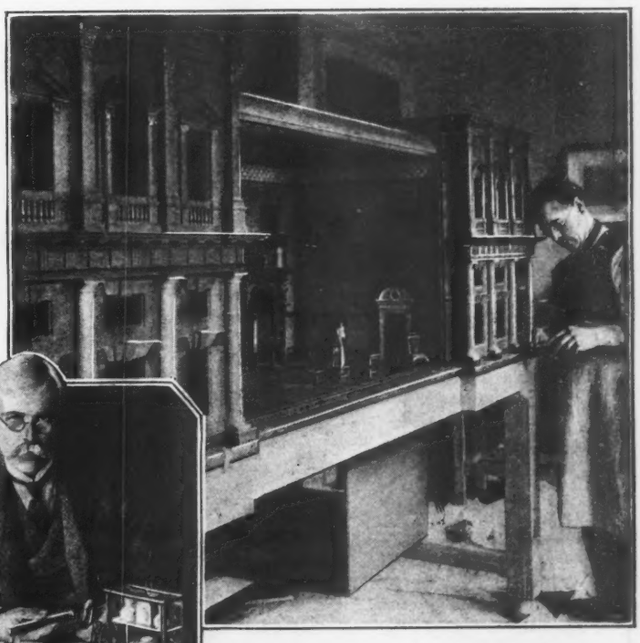
ONLY five inches long when fully extended, this pocket telescope will magnify 4½ times.

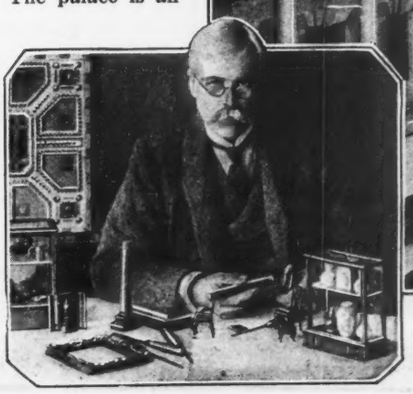
Such large magnification combined with a short focal length has been achieved by improved lens grinding and perfect mounting. The border of prismatic color in most inexpensive field glasses has been avoided by a new combination of glasses and the arrangement of apertures. The glass contains a concavo-convex flint objective lens with a double convex crown and a double concave flint eyepiece.

The World's Most Elaborate Doll Palace

THE most wonderful doll house in the world—"Titania's Palace," 2½ feet high, and covering 60 square feet—has just been built in Ireland by Major Sir Nevile Wilkinson, Ulster King at Arms, with two assistants. Chairs and tables little larger than postage stamps, bric-a-brac scarcely the size of peas, and marble and ivory statuary smaller than the maker's thumb, all precisely to scale, form the furnishings of the miniature palace.

The palace is an accurate model specimen of Florentine art, even the furniture being carved in the character of the period. The model will soon be exhibited in the United States.





"Titania's Palace" (above) and the builder, Major Sir Nevile Wilkinson (at left) exhibiting miniature Florentine furnishings

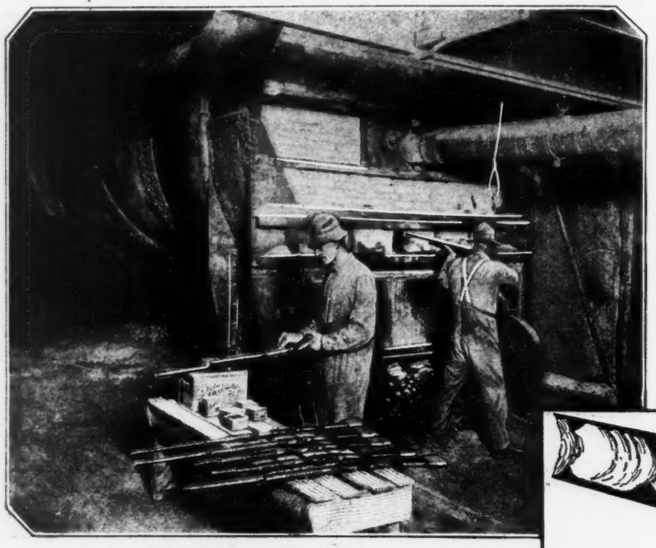
Marksmen Clean Cement Kilns with Shotgun Bullets

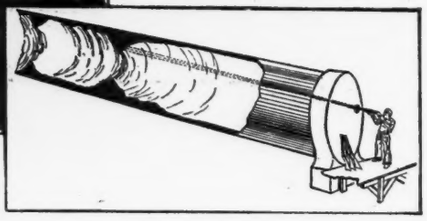
COMPLETING in two hours work that formerly required two or three days, marksmen armed with shotguns are now making sport of the once arduous task of cleaning cement kilns.

Bullets Replace Chisels

With charges of one-ounce lead bullets they shoot from the hot iron walls of the kiln accumulations of cement that formerly were chiseled out by hand after allowing the kiln to cool. These accumulations are caused by the intense heat which, when applied to the ground stone and other raw materials in the rotating kilns, fuses some of the cement to the iron walls in the form of a ring or crust that blocks the kiln.

The marksman, standing at the opening of the kiln, cuts away the ring by repeated shots from 12-gage shotguns.





Ringlike obstructions formed by cement fused on the walls of the kiln, as shown in diagram, are shot away by two men in two hours. One man loads repeating shotguns while the other fires

Once a wedge is cut from the ring, the entire mass falls when the kiln is rotated.

The fused stone is so softened by heat that when the shots strike, a distinct splash is heard. So many shots must be fired—from 250 to 1000 are needed to clean a kiln—and these are fired so rapidly that a single gun would become too hot to handle. For that reason 10 repeating shotguns are used, with one man loading and another shooting. A ring can be removed with shotguns at a cost of \$50. The hand chisel process cost \$1000.

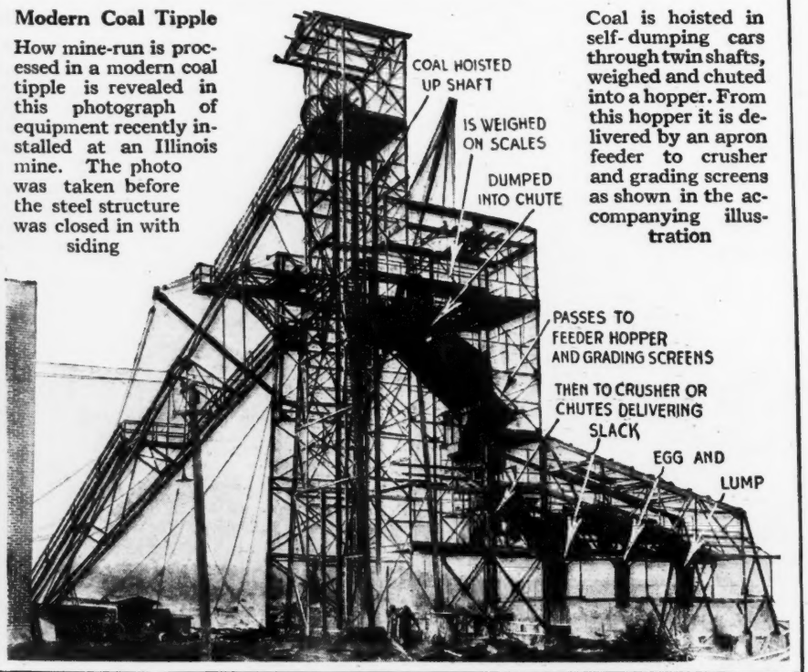
Half a Page of the Month's Most Novel Photographs

Chemical Fumes Test Air Currents

To indicate air movements in a dry kiln, chemical fumes are now being used. Fumes of hydrochloric acid are blown across ammonia, producing an abundance of harmless, visible fog

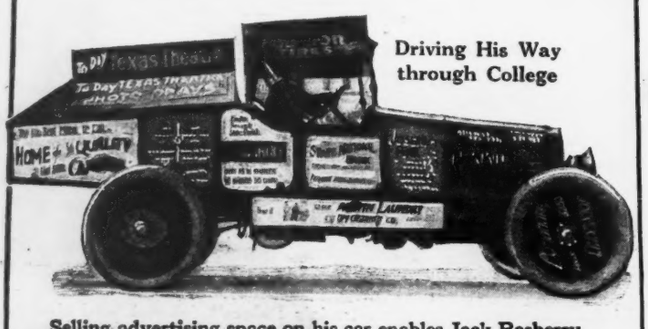
Modern Coal Tipple

How mine-run is processed in a modern coal tipple is revealed in this photograph of equipment recently installed at an Illinois mine. The photo was taken before the steel structure was closed in with siding



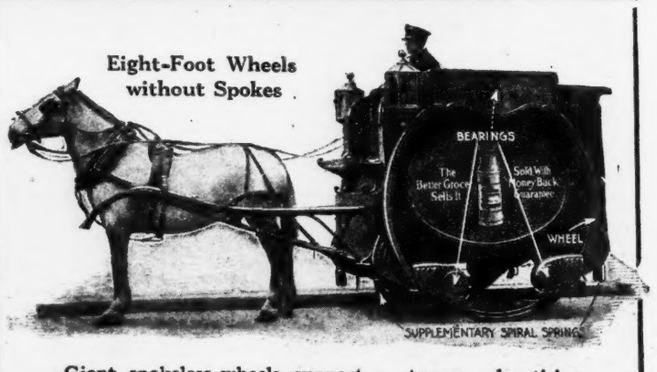
Coal is hoisted in self-dumping cars through twin shafts, weighed and chuted into a hopper. From this hopper it is delivered by an apron feeder to crusher and grading screens as shown in the accompanying illustration

Driving His Way through College



Selling advertising space on his car enables Jack Rasberry to pay his way through the University of Texas

Eight-Foot Wheels without Spokes



Giant spokeless wheels support a strange advertising wagon. The rims are supported by hidden roller bearings

wealthy families to have reproduced the

Every small thread must be placed ex-

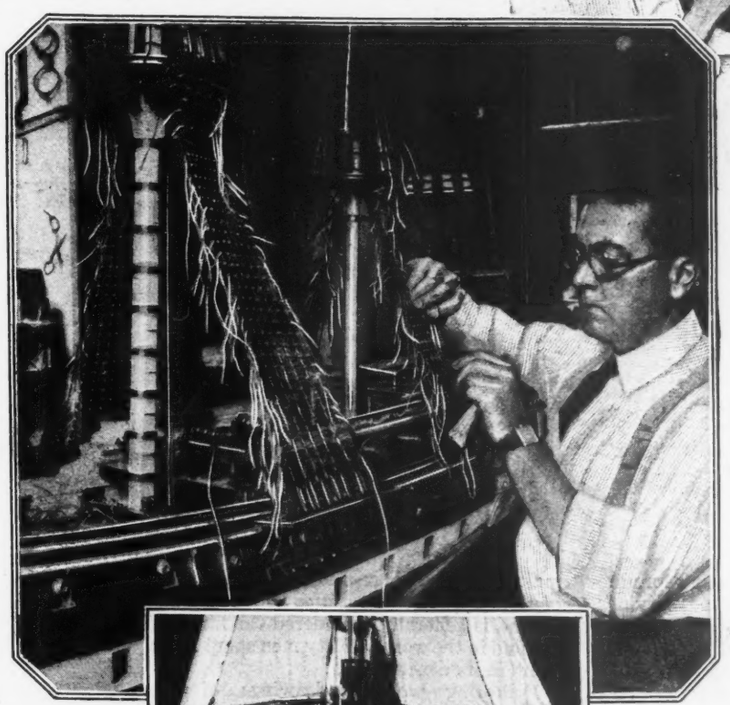
first constructed a wooden core slightly

How Skilful Tool Users Win Fortunes Building Models of Famous Old Ships for Millionaires

"THE building of ship models is undoubtedly established as one of the fine arts, and has wonderful possibilities of development.

"All ship models have a decorative value, while the finest examples are objects of real beauty that cannot fail to give the same pleasure we gain from a painting or statue. Many arts contribute to make these models beautiful.

"In the sixteenth century the designing of ships reached a degree of perfection that has remained unrivaled. Ships constructed then were among the greatest artistic achievements of their time, and in reproducing and preserving them we perpetuate objects of absolute beauty." — HENRY B. CULVER, *America's master builder of ship models.*



The master workman in America's revival of the ancient art of ship model building—Henry B. Culver—is shown above adjusting the rudder on one of his marvelous reproductions of sixteenth century men-of-war, for which millionaires pay him from $3000 to $20,000

At the left Mr. Culver is shown at work on the diminutive ship's shrouds which are almost as delicate as lace. Thin threads that reproduce the ropes of gallant vessels of the past are fastened with real sailor's knots

IF YOU should visit a certain remarkable house just a shout away from the teeming throngs of Broadway, in New York, you would find there a studious, busy man wearing the smock and shell-rimmed glasses of the artist; and on the workbench before him you would see a fascinating and beautiful model of a gallant man-of-war that sailed the seas in olden days, reproduced to the tiniest detail with marvelous craftsmanship.

Substantial Rewards

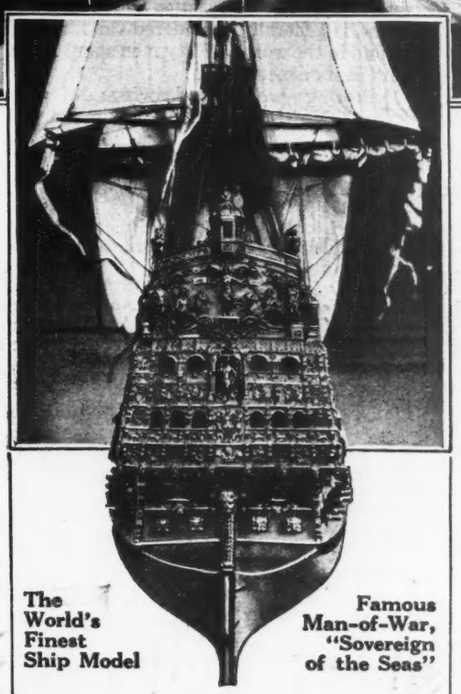
At first glance you might believe you were in the workshop of a maker of beautiful but useless toys—until you learned that for this one ship model the maker was to receive more than $10,000! Then you would understand how Henry B. Culver, now known throughout the world as a master of ship model building, has become a recognized leader in an amazing modern revival of this age-old art-craft.

America, in a few short years, has taken the lead in this revival, turning out intricate works of craftsmanship as costly playthings for Fifth Avenue palaces. An ever-increasing number of artist-shipbuilders—amateurs and professionals—are now receiving for their faithful reproductions of famous old wooden vessels of history fees ranging from $100 to $40,000. And the master craftsman of them all, Henry B. Culver, has made no fewer than 100 ship models within a period of 15 years, receiving for them usually not less than $3000, and for one, a masterpiece, more than $20,000!

Fascinating as Business or Hobby

But aside from liberal rewards, the professional ship model builders, as well as amateurs who follow model making as a hobby, agree that it is a most fascinating pastime for any person who is skilled in the use of tools.

It was this fascination, with the promise of substantial reward, that drew Henry Culver into the profession of ship model building some 15 years ago. But before he built his first model, he laid elaborate foundations for perfect craftsmanship. Though at the time he was an experienced and practical yachtsman, he spent months in preparatory research in the libraries and art galleries in America and abroad, collecting all manner of data on the original vessel which he was to model.



The World's Finest Ship Model

Famous Man-of-War, "Sovereign of the Seas"

Carvings that adorned the famous ship, "Sovereign of the Seas," were exactly reproduced by Mr. Culver and his assistants, as shown above. It took three years to build the model of this magnificent vessel—longer than the time required to build the original

Wanted—Experienced Shipbuilders

Then began a search for men whose experience qualified them for constructing units of a perfect reproduction of a historic sailing ship.

Assembling the intricate parts created by his assistants, Culver finally completed his first ship model, which he sold immediately to a connoisseur who appreciated its astonishing perfection of detail.

The building of miniature ships that never sail is by no means a new calling. Remarkable examples of the art have been discovered recently in ancient Egyptian tombs in a remarkable state of preservation.

Many of the earlier models were built by old retired sailors who had unlimited time and patience. The most famous of these are the "beef bone" models, carved by British sailors from pieces of beef bone, some of which are three feet long whittled out with surprising detail.

The present demand for ship models has been created largely by the desire of

Hand Pressure on Plunger

wealthy families to have reproduced the vessels that helped build up their fortunes. One New Englander whose great-grandfather was a prominent figure in the clipper-ship era at Boston, recently ordered models of 60 ships that had been owned and commanded by his ancestors. The prices he will pay for these ships range from $500 to $1000.

Considering the time and care required in building a faithful model, these prices cannot be called exorbitant. In some cases as many as 50 men, working under the direction of a skilful designer, may be required to complete a single ship. To assure perfect reproduction, every detail must be historically correct, and this may require months of research. The master model builder, besides being a craftsman must be an artist who can pass intelligently on the artistic reproduction of highly ornamental wood carvings, guns as they were mounted on the original ship, the color scheme and gilding, and finally the general effect of the complete model—for a ship cannot be reconstructed exactly to scale. If this were done, the mast and spars would appear too small.

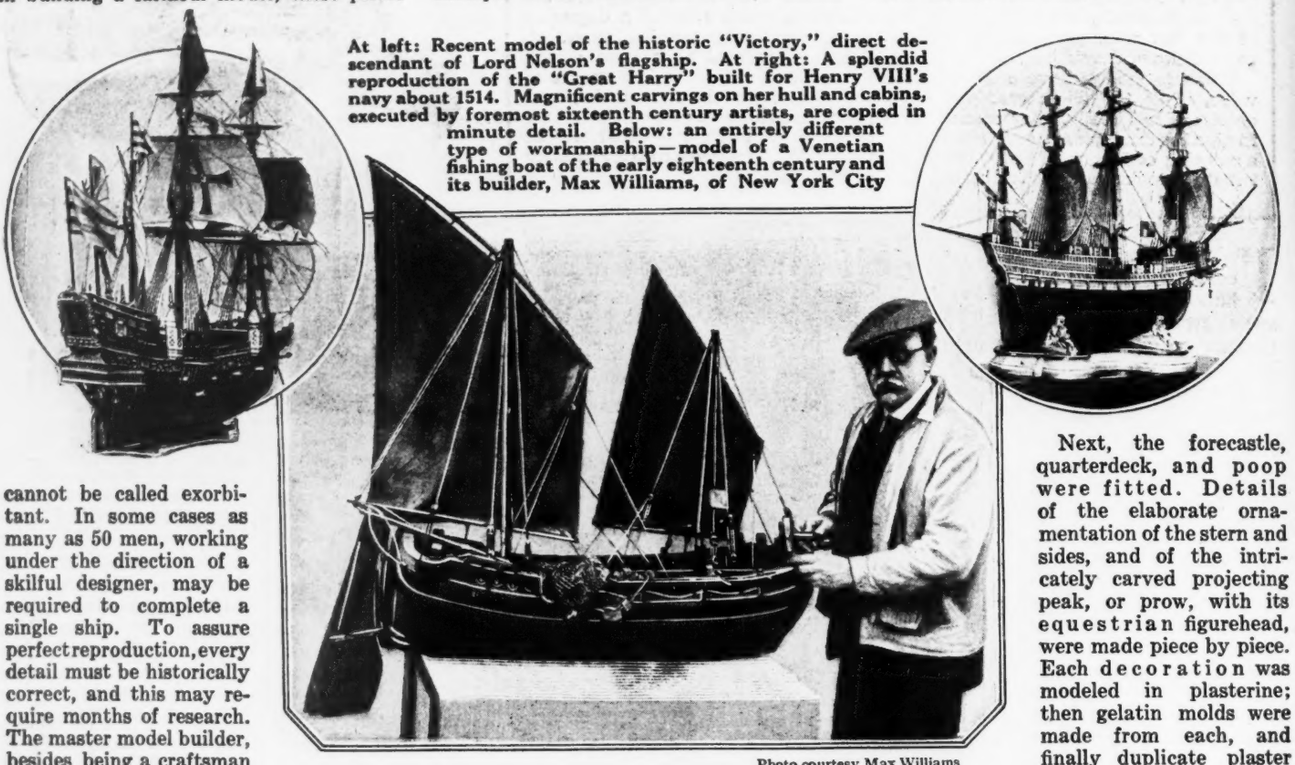
Modern ship models fall into three general classes. In one kind the hull is carved from a solid block of wood, usually mahogany. The second is built from a cradle or ribs, just as a real ship is built. Most model makers are using a third method—a laminated, or "bread and butter" hull. By this method, thin strips of wood are glued into a solid block the size of a ship's hull in such a way that the laminations will imitate the details of the ship. The rough block is shaped with wood carvers' tools—chisels, gouges, files, and sandpaper—and the craftsman works to the hundredth of an inch in order that the true scale may be preserved. Then the masts are stepped, the yards slung, and the intricate task of hanging the rigging begins.

Threads Spliced like Rope

Sometimes the delicate threads used for rigging are spliced just like large ropes. Tiny blocks and deadeyes are introduced so that the yards of the model can be trimmed by running rigging. Every small thread must be placed exactly as the ropes were arranged in the original type of ship, whether schooner, brig, or barkantine.

An extraordinary and extremely valuable model of the famous old British man-of-war, "Sovereign of the Seas," of 1637, reproducing the elaborate carvings and gaily colored ornaments that were the marvel of the seventeenth century, is a striking example of the intricacies of the model maker's art. This reproduction—the work of Henry Culver—measures 60 inches over all and is generally considered the finest of its kind in the world. Fifty men spent three years in its construction.

Following working drawings of the "Sovereign of the Seas," the model makers first constructed a wooden core slightly smaller than the hull, in removable sections. Over this core were built the stem, sternpost, keel, and ribs of the model. Then outer planking, one eighth inch thick, was nailed on. When the core was removed, the lower decks, with gun carriages and bulkheads, were placed in position. On the carriages were mounted more than 100 miniature brass cannon, each with a crown, royal cipher, and designs molded on it.



At left: Recent model of the historic "Victory," direct descendant of Lord Nelson's flagship. At right: A splendid reproduction of the "Great Harry" built for Henry VIII's navy about 1514. Magnificent carvings on her hull and cabins, executed by foremost sixteenth century artists, are copied in minute detail. Below: an entirely different type of workmanship—model of a Venetian fishing boat of the early eighteenth century and its builder, Max Williams, of New York City

Photo courtesy Max Williams

Next, the forecastle, quarterdeck, and poop were fitted. Details of the elaborate ornamentation of the stern and sides, and of the intricately carved projecting peak, or prow, with its equestrian figurehead, were made piece by piece. Each decoration was modeled in plasterine; then gelatin molds were made from each, and finally duplicate plaster casts were taken, from which the carvers worked.

All of Culver's models have hollow hulls and the construction throughout is surprisingly light. A complete ship model three or four feet in length may weigh less than five pounds. The complicated rigging of the great ships when reproduced in miniature resembles a delicate lacework. Even sailor's knots are reproduced in the thread "ropes."

Probably only half a dozen men in America possess the experience and ability to complete such an intricate task, which often requires more time than did the building of the original ship.

There are, however, scores of ship model builders who are skilled in less exacting craftsmanship, and many of these make an extremely good living from their work. One is a sea captain, who retired 30 years ago. At the age of 80 years he took up model making as a hobby and now earns more than as a sailing master.

Amateurs at Work

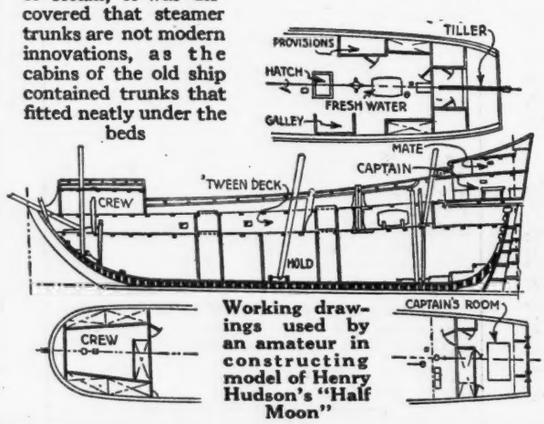
An increasing group of amateurs who have become interested in the revival of this ancient artcraft includes men from all walks of life. At present they have on their benches models of Columbus' "Santa Maria," Hudson's "Half Moon," an Egyptian galley that sailed 2000 B.C., and an American clipper, "Flying Cloud," the fastest sailing ship ever built.

Some New Facts about Old Ships

SOME surprising facts about ship construction in the olden days have been unearthed by artist-craftsmen who build ship models.

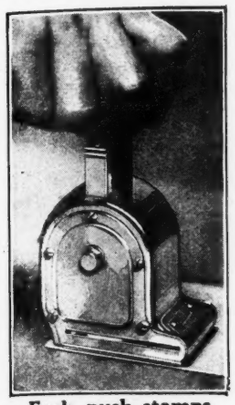
One builder, for example, discovered that radical changes were made in the famous American frigate, "Constitution," after every battle, even the mainmast being moved 10 feet forward between the time she left the ways and the close of the war of 1812.

In making another model of a ship in service 50 years before the days of steam, it was discovered that steamer trunks are not modern innovations, as the cabins of the old ship contained trunks that fitted neatly under the beds



Working drawings used by an amateur in constructing model of Henry Hudson's "Half Moon"

Hand Pressure on Plunger Stamps Envelopes



Each push stamps an envelope

A "RAPID fire" stamp affixer, which stamps envelopes as quickly as a person's hand can manipulate a plunger, has recently been invented and is being marketed by a Boston manufacturer. This little machine is operated by using coiled government stamps. As pressure is applied on the plunger, the machine moistens the envelope and sticks on the stamp.

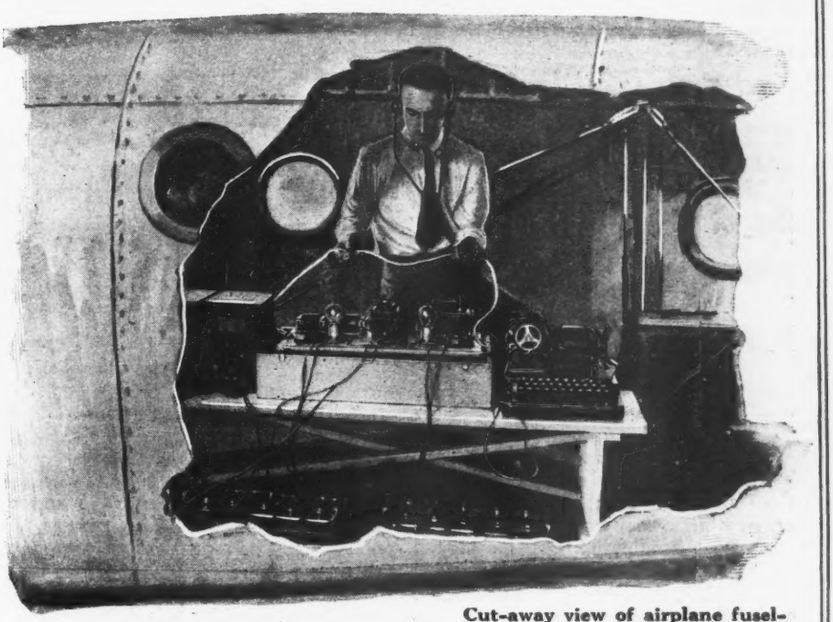
A Sheet of Rain 12 Feet Thick, and What It Did

TWO hundred and forty inches of rainfall over an area of four square miles, within half an hour!

Can you imagine what such a cloudburst would mean in a big city —a sheet of water 12 feet thick crashing down, wrecking buildings and perhaps drowning thousands?

Read, in next month's issue, a dramatic eyewitness account of the most colossal cloudburst in history—a 60-foot wall of water that recently wrought amazing destruction in the Sand Canyon of southern California.

Planes to Receive Typed Radio Messages



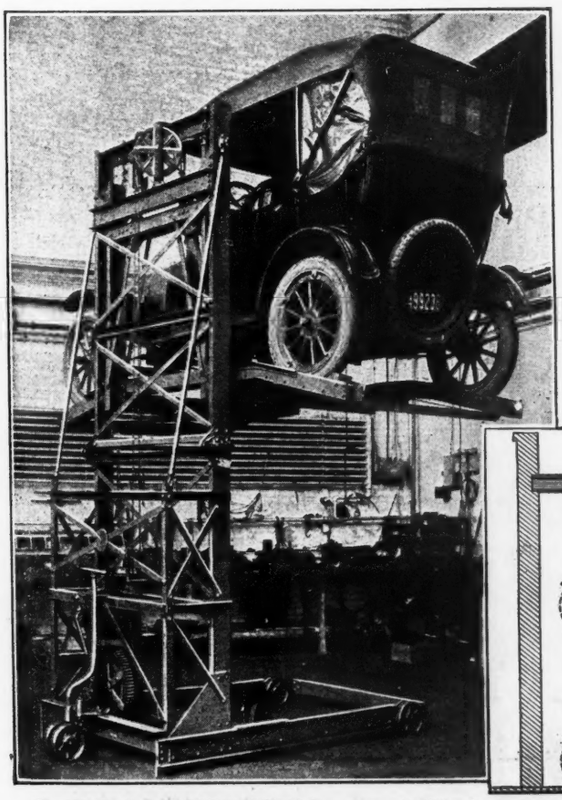
Cut-away view of airplane fuselage, showing how operator will receive typed radio messages

RECENT successful tests with the teletype in transmitting typewritten radio messages between the naval air station at Anacostia and the Bureau of Standards in Washington have led to further experiments looking toward the exchange of such messages in the immediate future between stations on the ground and moving airplane stations.

In transmitting, the message is first transcribed on a machine that translates the letters of the alphabet into dots and spaces of the so-called five-unit code and punches them through a paper ribbon. This ribbon is passed through an automatic transmitter that broadcasts the codified message with the aid of electric generators and thermionic valves, building up a current of the requisite power and high frequency.

In the receiving station the radio impulses pass through a recording instrument that retranslates the dots and dashes into type and prints it automatically on a paper ribbon.

Autos Hang from Ceiling in This Garage



By this elevating platform the auto is lifted to a storage balcony or to the ceiling, where the car is suspended from a beam, as shown in diagram

SPACE is conserved and car handling simplified in a Buffalo, N. Y., garage through the use of an elevator that lifts an auto to a storage balcony or to the ceiling, where it may be suspended by stirrup rods.

The elevator is placed in front of a car so that the wheels may run onto channel iron tracks of the elevator. Then the wheels are trigged and, by turning a windlass, a workman raises the loaded elevator to the desired height.

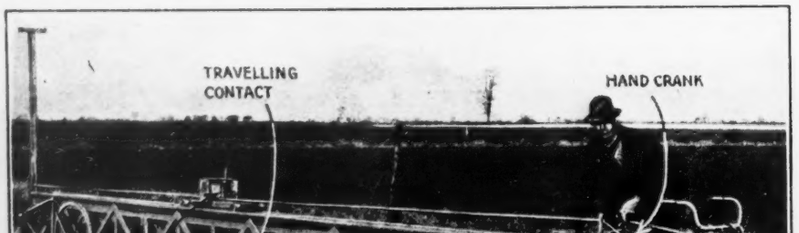
Compressed-Air Tool Blows Old Paint from Walls

OLD paint blisters can be blown off the house by a compressed-air paint remover recently invented by Mr. E. T. LaRoche, of Philadelphia, Pa., to replace the old method of blowtorch and scraper.

The new invention is a combination scraper and blower. Compressed air is blown toward the point of the scraper from an outlet situated about two inches above the under surface of the cutting edge. As the operator, applying pressure to the tool, moves it over a painted wall, the edge of the scraper cuts under the paint in several places. The compressed air then blows off the paint that the scraper has loosened.

The compressed air is supplied by a portable outfit and is led to the scraper through a flexible hose.

Girder-Cycle Measures Bumps in Road



ACCURATE measurements of the unevenness of a roadway following the completion of traffic tests upon it, are now possible by means of a recording device originated by the United States Bureau of Public Roads.

A latticework girder, suspended from cycle wheels, furnishes a perfectly flat surface over which the recorder moves. A small wheel, making contact with the road surface, communicates the varying contour to the recording pen as the operator by turning a crank draws the carriage along the length of the girder.

Minute undulations in road surfaces can be recorded by this device.

Why Frozen Milk Breaks Its Glass Container

WHEN a bottle of milk freezes and breaks its container, the disaster should be blamed on the water that comprises 87 per cent of the volume of the milk. When water is cooled, it contracts until a temperature of about 38 degrees F. is reached, then, due to a change in the molecular structure of the matter, the volume commences to increase. The increase is practically irresistible.

How expansion cracks the bottle

In the illustration the expansion of the water forced the frozen mixture out of the top.

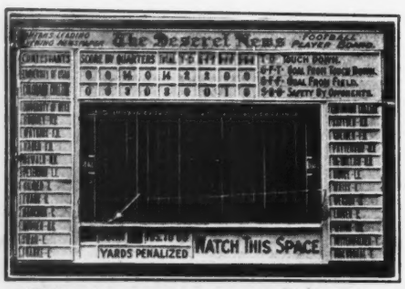
But the cooling was carried out so rapidly that the pressure was relieved too slowly and as a result the bottom of the bottle burst.

Football at Long Distance on New Scoreboard

HUNDREDS of miles away, the halfback plunges through tackle for 10 yards, and the fans at home roar with appreciation. They have followed the play in all its detail on a new mechanical football scoreboard invented by the staff of *The Deseret News*, Salt Lake City, Utah.

The black square ruled to represent the gridiron is made of zinc. Concealed behind it is a movable electromagnet moved by the operator in response to directions telegraphed from the side lines. The small iron ball on the outside of the board follows the magnet, and travels up and down the board, depicting every move of the game.

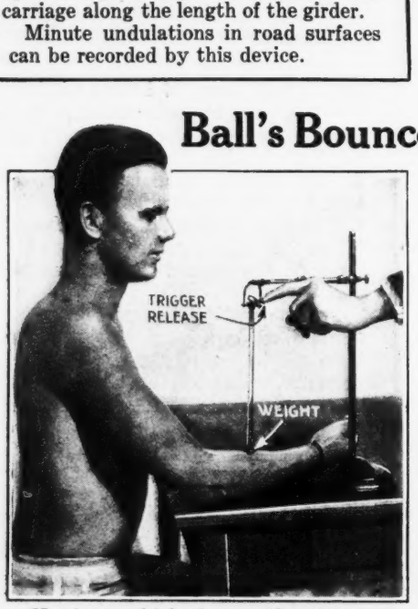
A slide, marked "Ball," indicates which team is on the offensive. Arrow indicators point to the name of the player carrying the ball. Cards inform the spectators of the down and the yards to gain, while in a larger slot appears such special information as "Forward pass complete," By having a direct wire to the football field, each play can be reproduced on the board a few seconds after it is made.



Following a magnet moved by the hidden operator, the ball indicates every play

A THEORY that dyes of various colors, applied to the intestines, will kill disease germs has been tested, with claims of success, by Dr. Paul A. Lewis, of the University of Pennsylvania, in experiments with thousands of color combinations.

Ball's Bounce Tests Muscle "Tone"



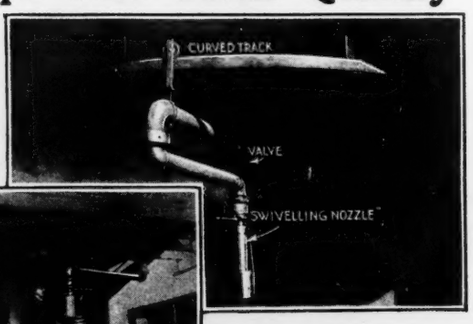
Height to which the small weight rebounds measures tone of the muscle

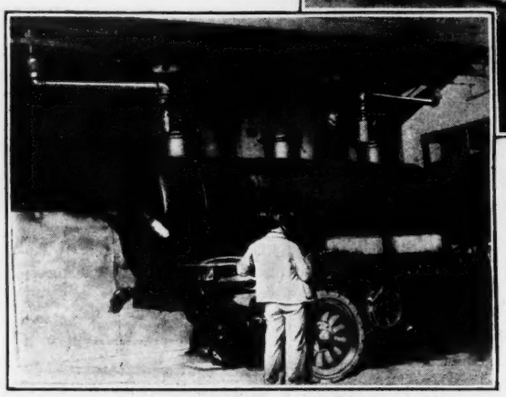
IN STUDYING the effect of fatigue on the muscles of athletes, Dr. R. W. Schulte, of Berlin, Germany, has developed an ingenious measuring apparatus to determine exactly the degree of fatigue after certain exercise and after prolonged continuation of muscular activity.

Suspended from the adjustable arm of a weighted supporting stand is a glass tube with etched-in calibration marks. This tube is placed vertically, with its lower end resting on the muscle to be tested, When the observer presses a trigger, a small metal ball, held by a catch, is released and allowed to drop on the muscle. The better the tone of the muscle, the higher will be the rebound of the metal ball, which is ascertained by the observer by reading the calibration marks. By comparison the degree of fatigue and the speed of recuperation may be ascertained.

Swiveling Pipe Fills Tank Quickly

ANY gasoline truck can be filled at the station of the S. T. Johnson Co., Oakland, Calif., without the delay of "spotting" the tank opening directly under the spout, thanks to an ingenious swiveling discharge pipe that is attached near its elbow to a small trolley running on a circular track.





To fill the tank truck, the operator swings the pipe along this track, then bends the outlet to the proper location above the tank.

Clock Is Driven by Its Own Weight

A SILENT clock that indicates by its position on its upright supports when rewinding is necessary is propelled by force of gravity acting on the timepiece.

As the clock runs down, it slides down the pillars

To set the clock in motion the entire mechanism, including the face, hands, and pendulum, is raised to the top of two vertical pillars forming its support. Ratchet wheels on the clock engaging a rack cut into the side of one of the pillars transmits the gravitational force to the pendulum and balance. As the clock runs down, its position on the pillars becomes lower.

The pendulum consists of a vertical bar pivoted at the center near the escapement and bearing at its ends adjustable weights. By altering the position of these weights the motion of the pendulum is controlled.

Having no key to lose, no springs to break, this clock is the last word in simplicity.

Circular Saw Can Cut Piles Below Water

A CIRCULAR saw that cuts 75 piles an hour when submerged under water is being used on pier work in Philadelphia, Pa. Over 7600 pile heads are to be removed.

The outfit consists of a 48-inch circular saw attached to the bottom of a long shaft operated by a 35-horsepower motor on its upper end. A traveling bridge mounted on wheels runs the entire width of the pier, driven by a compressed air engine. Two 14-inch I-beams on the bridge act as rails for the side movement of the saw rigging. It is possible to cut off 225 piles in three hours when the water is at low tide. A workman standing at water level cools the saw by dashing water on it when not submerged.

Courtesy *Successful Methods*

Mounted on a traveling bridge, the saw is attached to the bottom of a long shaft

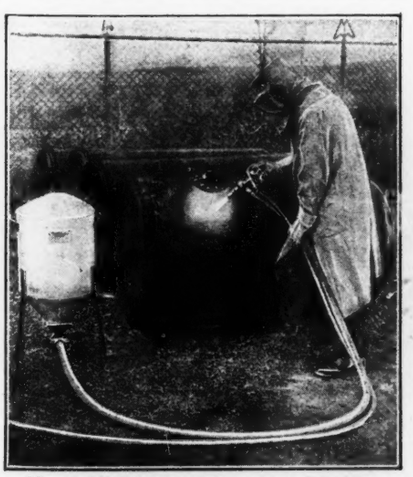
Portable Sand Blast Cleans Quickly

EVERYDAY use of the sand blast for all kinds of difficult cleaning has been made possible by a new portable outfit that is simple and effective in operation. The invention consists of a new blast gun that can be used alone or in connection with a cabinet. Compressed air, controlled by a trigger in the handle of the gun, passes through the air jet and creates a vacuum by which the sand is sucked from the hopper into a mixing chamber. The air pressure is regulated to suit the requirements of the article that is being cleaned.

Small articles are cleaned in a cabinet of sheet steel. Here the gun is stationary, and the sand hopper is placed under the chamber. The operator turns the work over and over in the blast stream until it is cleaned. Canvas sleeves protect his hands. He watches the work through a sight screen at the top of the box. The spent abrasive falls back into the sand hopper, and in this way the cleaning operation is continuous.

The outfit may be employed to clean paint from metal, finish off castings and stone work—in fact, wherever an abrasive is needed for a special job rather than for large standardized output.

Small objects are cleaned in a steel cabinet surmounting the sand hopper and inclosing the blast gun. The work is observed through the screen at top

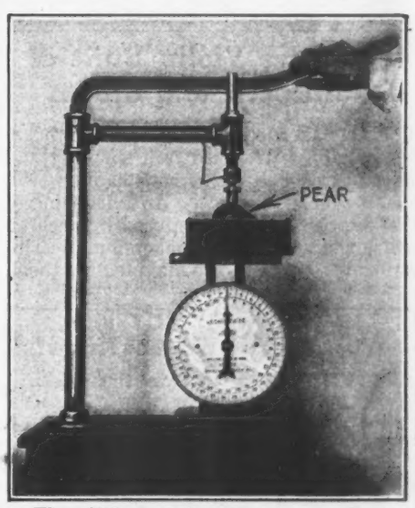


How the blast gun is used to clean large areas of metal

Mechanical Tester Tells Ripeness of Fruit

TO DETERMINE just when pears and apples should be harvested, Prof. W. S. Brown, of the Oregon Agricultural Station, pinches them with a scientific tester.

The degree of ripeness is determined by the number of pounds pressure on the hand lever required to force the plunger into the pear or apple a predetermined distance. The invention is exceedingly accurate, and orchardists expect to save thousands of dollars, since its use insures that the fruit will reach the market in the best condition.



The dial records pressure required to force a plunger into the pear

Largest Bulb Shed Light for This Photo

© Keystone

This remarkable photograph of the new Ocean House at Swampscott, Mass., was made in 30 seconds by the light of a 30,000-watt electric bulb, shown at right

THE world's largest electric-light bulb, consuming one third of the power required to run an average trolley car, has been constructed for motion-picture studio work, by a concern in Cleveland, Ohio.

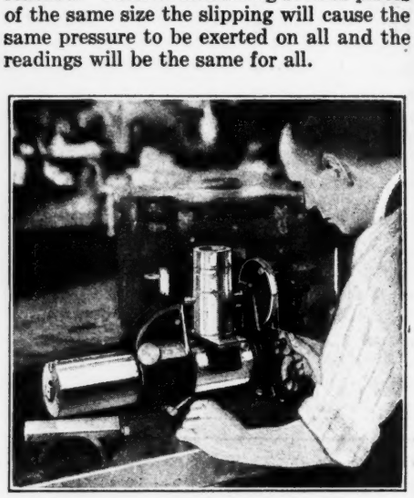
Thirteen of these lamps have already been constructed for use in a picture studio in Schenectady, N. Y. The light they produce is said to be the nearest approach to sunlight yet achieved.

The monster lamp uses 30,000 watts and produces 60,000 candlepower—the equivalent of 2400 electric lamps of the size usually used in the home. It is 12 inches in diameter and 18½ inches high and requires enough tungsten filament to supply 55,000 lamps of the 25-watt household variety.

Measuring Work to Ten Thousandth of an Inch

A SUPER-MICROMETER, capable of making measurements to one ten-thousandth of an inch, yet rugged and simple enough to be placed on any workman's bench, has been perfected by a New York concern. The machine consists of a rigid cylindrical bed, a dividing head and an adjustable foot stock. It has a range of eight inches between anvils and 3¼ inches between the anvils and table.

The screw has a working range of one half inch, indicated by graduations on a forged duralumin index wheel and on a measuring spindle. The work to be measured is placed upon the table between the anvils and the spindle is run quickly up to the work. A larger hand wheel for the final slow movement to contact is connected with a round belt that slips when a certain pressure upon the work has been reached. Thus in measuring several pieces of the same size the slipping will cause the same pressure to be exerted on all and the readings will be the same for all.



The super-micrometer, showing large adjustment wheel with slip-pulley regulator

Primitive Violin Built of Rainspout and Broom

STRANGE violins, with sounding boxes made of galvanized iron spouting and fingerboards built of broom handles, will soon be on the market. After listening to the surprising music produced by such an instrument, an Eastern maker of musical instruments has began to manufacture them.

What Do You Want to Know?

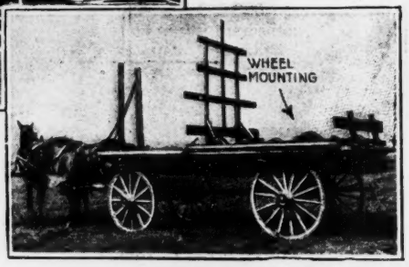
OUR Information Department will gladly answer any specific questions on general or applied science. Address the Information Editor, Popular Science Monthly, 225 West 39th Street, New York City, inclosing self-addressed stamped envelope.

Mechanical Harvest Hand for Hay Wagon

OBSERVING the effort expended by two men and a boy in pitching hay forward on the wagon after the hay dropped from a loader, an Ohio farmer recently conceived the idea of a mechanical harvest hand to move the load forward on wheels, and thus save the labor of one man. He built a truck 6½ feet wide and 7½ feet long with four small wheels, adjusted to run on a track formed by the two-by-four-inch side rails of a wagon rack.

The truck is equipped with two long stakes and crossbars at the front end and short stakes with one crossbar at the rear end. Hay is loaded on the truck at the rear of the wagon. When filled, the truck is pushed to the front, and the remainder of the load is placed on the rear of the wagon rack. This simple device makes it necessary to handle the hay only once.

To prevent the small truck from rolling along its track during the loading, steel spring arms reach over and under the rack rails.



At the right the ingenious loading truck is shown in position at the rear of the wagon rack ready to receive load of hay. When loaded, the truck is rolled to the front of the wagon and the rear of the wagon rack receives the remainder of the load

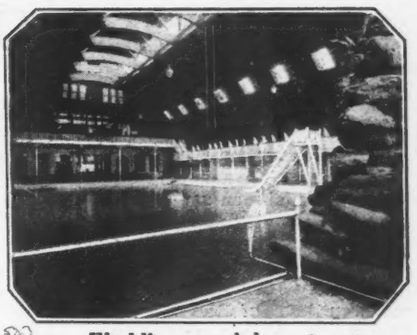
Artesian Wells Heat Boise Homes

THE present fuel shortage holds few terrors for many of the residents of Boise, Idaho, for they are supplied with natural heat from hot water artesian wells near the city. The wells, with a capacity of 1,500,000 gallons a day, supply enough water at 170° F., not only to meet the needs of a large natatorium, but in addition to heat hundreds of homes and office buildings in the vicinity of the wells.

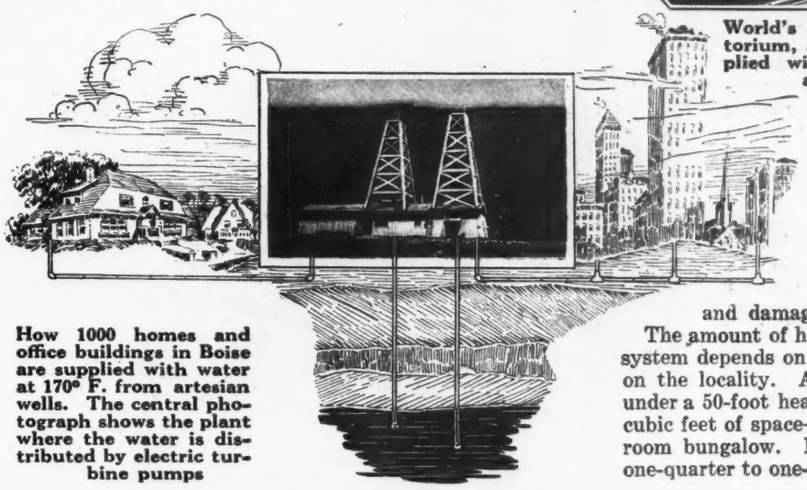
Two six-inch wells originally were drilled to supply heated water for the pool. There was found to be a surplus, however, and pipe lines were extended to the radiator systems of near-by homes. Two new eight-inch wells were drilled and compressed air was fed to the wells. This caused serious oxidation and later the same percentage of flow was obtained by installing electrically driven turbine pumps.

This ingenious heating system has demonstrated its usefulness, especially because of its cleanliness and economy, and it is probable that the fuel shortage will extend its development. A five-sixteenth-inch feed pipe, ordinarily the largest used, has a yearly rental of $160. This supplies hot water for all kitchen, bath and heating purposes, as well as the free service of the heating company for cleaning, waste removal, and reasonable repairs. The large pipe is used in office buildings, where the usual outlay for winter coal alone would be $800, to which would have to be added the cost of furnace care, ash removal, and damage to furnishings by soot.

The amount of heat to be derived from the system depends on the size of feed pipes and on the locality. A one-third-inch feed pipe under a 50-foot head of water will heat 20,000 cubic feet of space—sufficient heat for a five-room bungalow. Larger buildings use from one-quarter to one-half-inch pipe.



World's second largest natatorium, at Boise, Idaho, supplied with hot water from artesian wells



How 1000 homes and office buildings in Boise are supplied with water at 170° F. from artesian wells. The central photograph shows the plant where the water is distributed by electric turbine pumps

America's Longest Retarding Coal Conveyor Brakes Itself

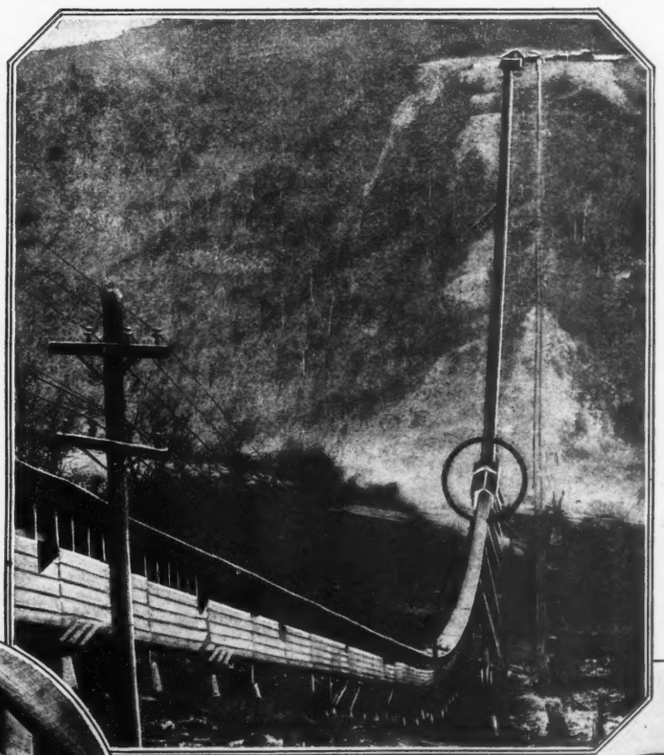
TWO coal conveyor troughs extending downward from head houses on opposite slopes of a deep valley to a central tipple structure, are said to form the longest retarding conveyor in America.

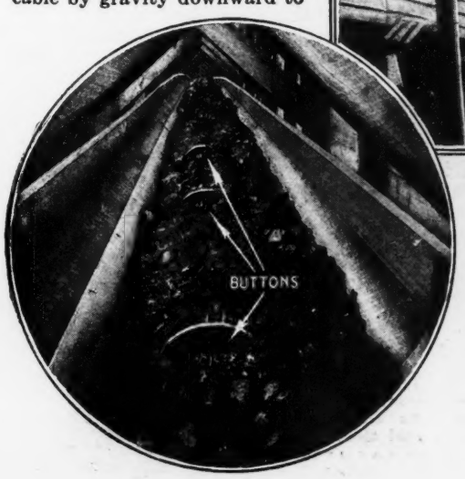
They are located near a coal mine in Fayette County, W. Va., where the coal outcrop occurs on two ridges about 700 feet above the central valley. The total length of the conveyor is nearly half a mile.

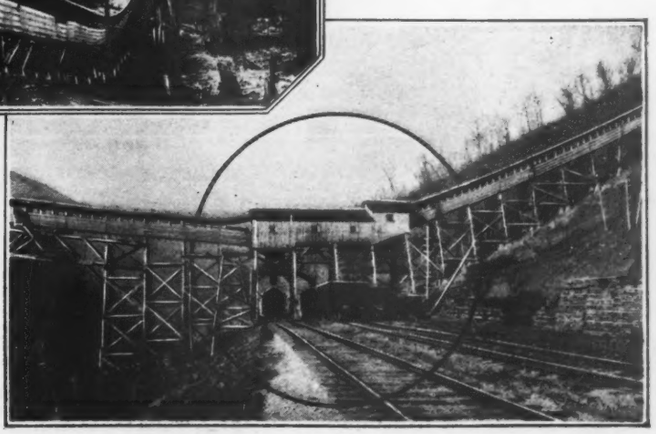
The conveyor is of the cable-and-button type, and uses the weight of coal for its operation. The buttons are metal disks attached to a cable that runs along the base of the trough. They serve to retard the lump coal as it is dumped into the conveyor at the head houses. The weight of the coal thus retarded moves the conveyor cable by gravity downward to the tipple at the bottom of the valley.

In the downward movement, the larger lumps being retarded by the buttons, the slack falls between the cable and the edges of the trough lining, and the friction thus produced serves as a brake to assist in preventing the conveyor from running away. In addition, surplus power created by the weight of the coal is transferred to a shaft which is connected with a combined belt and brake pulley device, the operation of which is automatic.

At the head houses, coal is fed to the conveyor at the rate of 30 tons an hour by a distributing plate with prongs. Men stationed along the side of the conveyor pick out any impurities, such as slate, which they throw into chutes emptying on to the hillsides.







Above: From head stations on opposite hillsides, immense gravity conveyors carry coal to a central tipple at the bottom of the valley (at right), where the coal is delivered to freight cars. At left: One of the conveyor troughs

Desert Oasis Open to Public

LUXURIANT tropical vegetation, suggestive of the flora of an oasis in the Sahara Desert, may be seen in Palm Canyon, the newest of Uncle Sam's national monuments. This remarkable valley and its immediate surroundings within the reservation occupy an area of approximately 1600 acres near the northern end of the Colorado Desert in California, not far from the Mexican border.

To the south is the desert, to the east and west are wide stretches of desolate prairie alternating with rugged and barren mountain chains. In remarkable contrast to these surroundings, Palm Canyon and the other two canyons which it includes, contain a wealth of tropical and desert vegetation, to be found nowhere else in the United States. The three canyons are inclosed by precipitous walls of rock and are abundantly irrigated by turbulent mountain streams fed by never failing springs. In sharp contrast to the terrific heat of the desert, Palm Canyon enjoys delightfully cool climate.

This interesting reservation is reached with difficulty because of the desert approaches. The State of California, aided by the Federal government, is now building an automobile road that will connect the reservation with roads of southern California.

This exceptional photograph shows the luxuriant vegetation in Palm Canyon (see map at left)

A tentless camp in Palm Canyon, southern California, a tropical garden spot surrounded by parched deserts and said to contain the only native palm trees in the United States

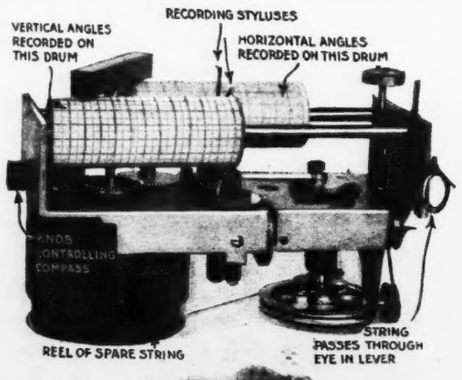
One Man Surveys Land with Automatic Charting Instrument

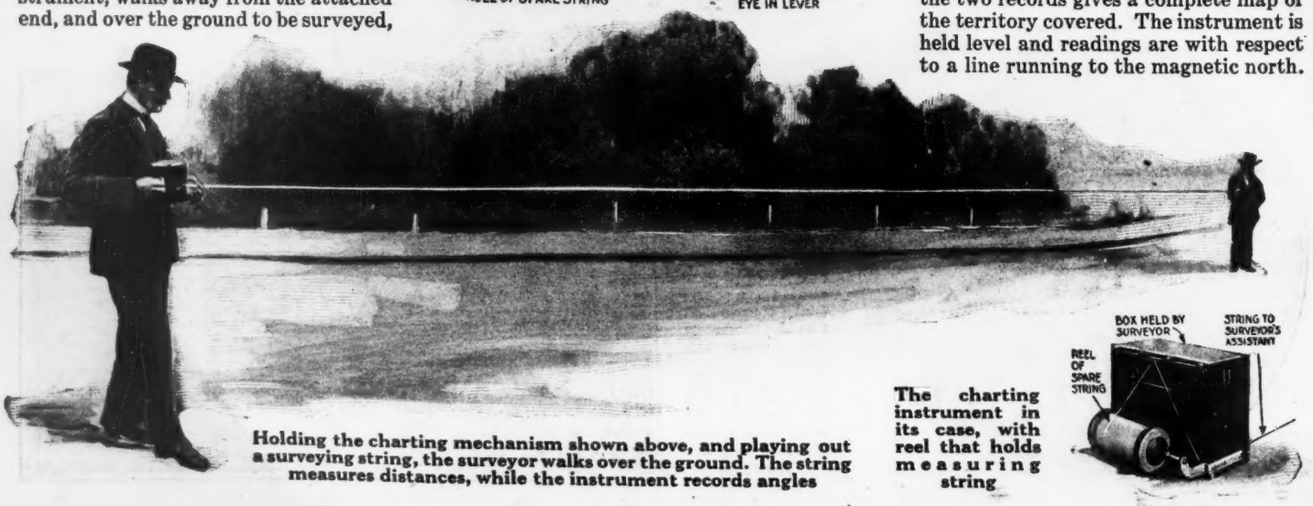
AN AUTOMATIC charting instrument with which an explorer or surveyor can quickly make a fairly accurate map of any tract of land or river course, and which can be operated by one man, has been perfected by a French inventor.

The essential parts of the instrument include a compass, recorders for vertical and horizontal angles, controls for compass and recorders, and a surveying string.

The free end of the string is held by an assistant or may be attached to a tree. As the operator, holding the instrument, walks away from the attached end, and over the ground to be surveyed, he moves a lever with his left hand in the direction of the twine, and with his right hand adjusts a knob that controls the movement of the compass. The movement of the lever determines the angular displacement in elevation. This movement is transmitted to an elevation recorder in which a stylus marks a record on a revolving drum.

This curve, deciphered in relation to the distance covered by the operator, determines the differences in elevation between two points. The movement of the compass is similarly recorded on another roller and the combination of the two records gives a complete map of the territory covered. The instrument is held level and readings are with respect to a line running to the magnetic north.


VERTICAL ANGLES RECORDED ON THIS DRUM
RECORDING STYLUSES
HORIZONTAL ANGLES RECORDED ON THIS DRUM
KNOB CONTROLLING COMPASS
REEL OF SPARE STRING
STRING PASSES THROUGH EYE IN LEVER



Holding the charting mechanism shown above, and playing out a surveying string, the surveyor walks over the ground. The string measures distances, while the instrument records angles

The charting instrument in its case, with reel that holds measuring string

My Most Thrilling Parachute Jump

By Master Sergt. Ralph W. Bottriell, U. S. Air Service

ONE thrilling experience I shall never forget occurred when I made a parachute jump from 20,600 feet above McCook Field, Dayton, Ohio, with Master Sergeant Strong B. McDan as my pilot. I had just signaled McDan that I was leaving the cockpit of the plane for the jump when part of my parachute harness caught on the gun turret, pulling the rip cord of my pack and releasing the parachute.

Quicker than I could think, the wind caught the chute. I was jerked out of the cockpit and whipped right through the rudder of the plane. The pull was so terrific that the impact broke the rudder as I tore through it. The blow knocked me unconscious, and I dropped 5000 feet before I regained my senses.

Then I observed that one panel of the chute had been ripped by its contact with the rudder and I also realized that my left arm was numb. I thought at first that the arm was merely broken until I discovered that blood was streaming from my hand at such a rate that I would probably bleed to death before I landed, if it continued. So, lifting the injured arm high above my head, I fastened the limp hand in the webbing of the chute. Three times my hand worked out of the webbing and dropped down, but each time I was able to lift it up again and finally I fastened it above my head.

With the wind rushing through the rent panel of the chute, I knew that my landing would be much harder than usual. I therefore pulled the jerk cord of my emergency parachute, which checked my drop, and I alighted in a field. There I was given first aid, and later taken to the McCook Field hospital.

Meanwhile, McDan, who knew nothing of my abrupt departure from the plane until he attempted in vain to use his shattered rudder, maneuvered his disabled plane with masterly skill, and succeeded in making a safe landing.

Pushbuttons Sort Parcels in This Remarkable Laundry

A SORTING machine invented by John R. Sousa, of Washington, D. C., to facilitate the work of distributing finished pieces in laundries, is operated entirely by pushbuttons within reach of the man at the sorting table.

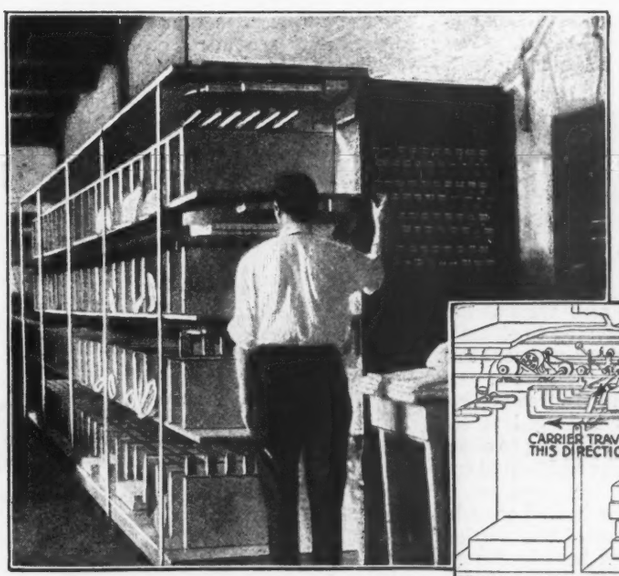
The device consists of several tiers of bins or compartments, each bin corresponding to a customer. Above each tier is a miniature railway along which a carriage runs. When the operator presses a button to have the load on the carriage dumped in that bin, a rake is raised by a magnet. This rake consists of several fingers that when raised protrude through the grillwork of the carriage and sweep off any bundle that may be on it.

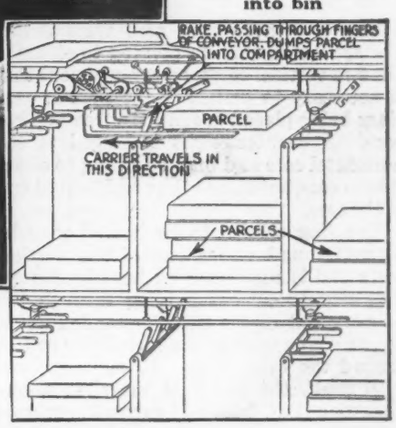
Every Carriage Has Its Motor

As the package is deposited in its compartment, an automatic latch reverses the motor and sends the carriage back to the sorting table. At the same time a cam returns the rake to its normal position.

Each carriage has its separate motor and double trolley that conducts the current for running the motor from the 12-volt storage battery.

One of the machines now in use in a laundry at Washington has 80 bins arranged in four tiers with tracks and carriage for each tier. This machine is controlled at a switchboard with eight rows of 10 pushbuttons each. Above each button is a card with the customer's mark. Each carriage is controlled by two rows of buttons.




RAKE PASSING THROUGH FINGERS OF CONVEYOR DUMPS PARCEL INTO COMPARTMENT
PARCEL
CARRIER TRAVELS IN THIS DIRECTION
PARCELS

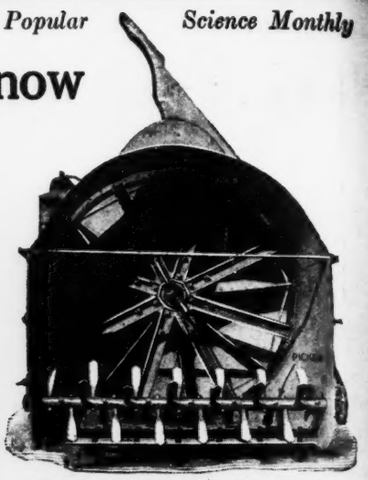
By pressing pushbuttons, each corresponding to a customer, the operator distributes parcels of laundry into individual compartments, as shown at left. The diagram of the ingenious sorting mechanism, below, shows how rakes sweep parcels from carrier into bin

Rotary Plow Spouts Stream of Snow

EQUIPPED with a spout that throws a stream of snow 200 feet to either side of the road, a new rotary snow plow that will clear a swath 6½ feet wide has been perfected by a Wisconsin motor manufacturer. It is reported to have met with extraordinary success in clearing away deep drifts on the steep roads of the Sierra Nevada Mountains.

Revolving Picks Break Up Hard Snow

The snow-digging mechanism consists of a fan and picker arrangement, mounted on the rear of a truck which, with rear and front drive wheels, can be driven backward over the road to be cleared. A horizontal shaft, to which are attached 30 pickers, is rotated by a motor located just behind the driver's cab. The revolving picks break up the compact, frozen snow ahead of the truck and permit the advance of the machine into the broken-up material.

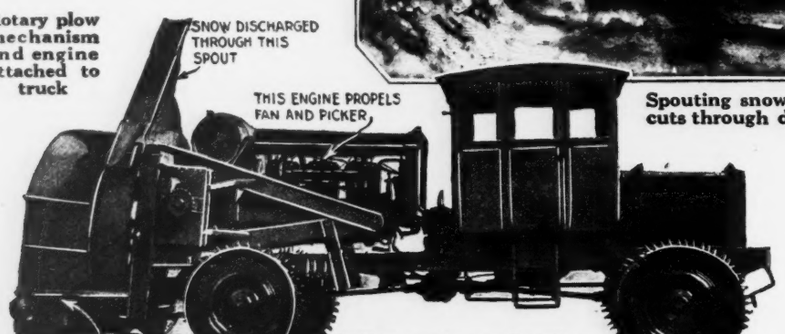


The "business" end of the truck-plow, showing picks mounted on rotatable shaft to break up packed snow, and behind them a vertical fan to blow the snow through discharging spout

A vertical fan immediately behind the picks blows up this material into a chute leading to a spout pointing diagonally upward, which can be tilted to right or left, according to the side of the road on which the snow is to be deposited. From this chute the snow shoots diagonally upward like a high pressure stream at a velocity that carries it 200 feet beyond the side of the road.

During tests conducted at Huntington Lake, near Fresno in the Sierra Nevada Mountains of California, about 10,000 feet above sea level, the most severe conditions were encountered, grades of 30 per cent being met and overcome. Under such conditions picket wheels were required, although for ordinary conditions chains are used.

The machine is so constructed that, in the summer, the snow plow can be removed and the truck used for hauling.


Rotary plow mechanism and engine attached to truck
SNOW DISCHARGED THROUGH THIS SPOUT
THIS ENGINE PROPELS FAN AND PICKER
CHAIN DRIVE TO PICKER

Spouting snow, the plow cuts through deep drifts

Electric Current Heats Metal Tires and Gears Automatically

HEATING metal tires or gear rings, preparatory to shrinking them on wheels, is now accomplished automatically by means of an induced electric current passing through them, in an ingenious apparatus perfected by a Swiss manufacturing concern. This apparatus, designed on the principle of an electric transformer, has three laminated iron cores —two vertical and one horizontal—and a primary coil, with adjustable wiring, placed around one of the upright cores.

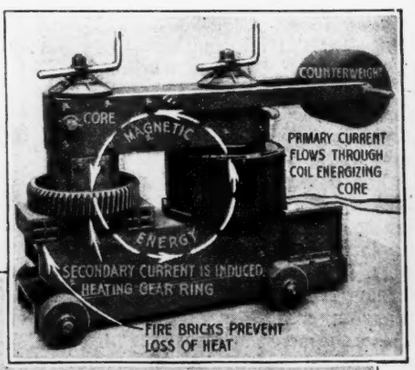
Gear Ring Placed around Core

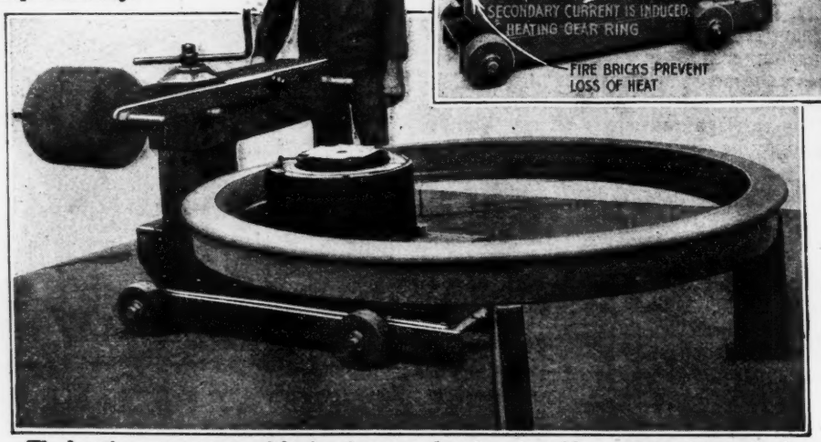
The long horizontal core surmounting the apparatus may be pivoted to either of the two vertical cores, an arrangement that is necessary to permit of the tires or gear rings being placed around the free vertical core. A counterweight is hinged to the horizontal core and may be swung to either side to counterbalance the unsupported end of the core.

The ring or tire to be heated may be placed around either one of the vertical cores and is supported by heat insulators. The electric current passing through the primary coil of the transformer induces a secondary current in the metal ring or tire around the other core. Being connected with itself, the metal of the ring, short-circuiting the induced current, becomes heated and expands so that then it can be shrunk on the wheel for which it is intended.

The heating with the aid of this type of transformer requires little time and practically no attention, as it is automatic from the moment the primary coil is switched on. The work is done cleanly and quickly.

Mounted on a wheeled truck, the heater may be moved to any part of the shop or factory.





The heating apparatus, with circuit open, showing tire of locomotive drive wheel in position. Inset shows gear ring being heated by induced current

Navy Builds America's First Rigid Airship to Prove Commercial Possibilities of Huge Airliners

Undaunted by recent disasters, Uncle Sam is going ahead with "ZR-1," as the forerunner of giant dirigibles that will cruise 5000 miles with 400 passengers

By Ernest Jones

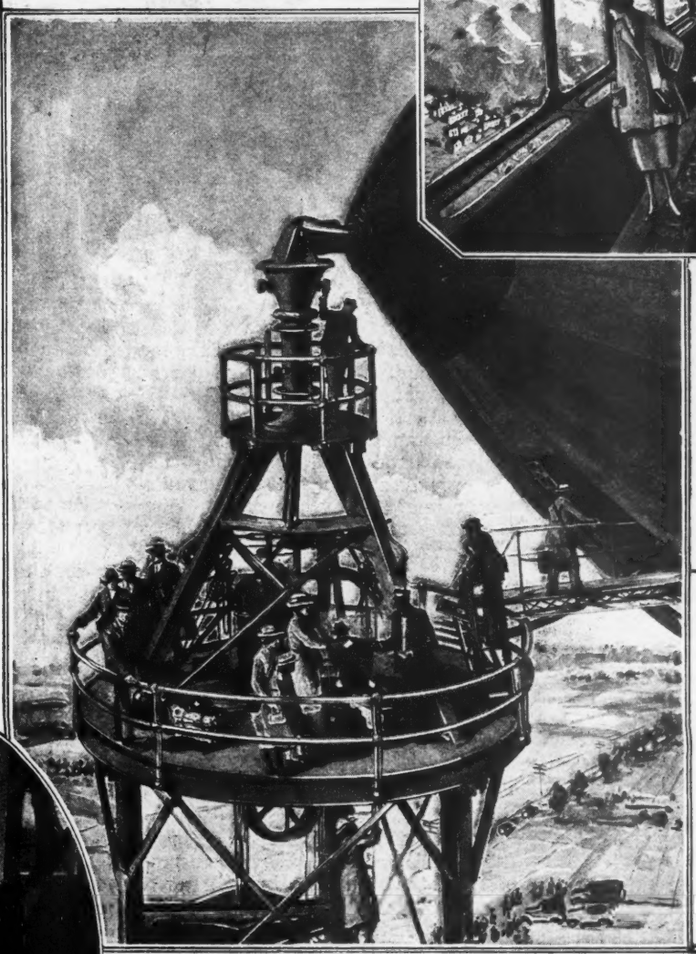
UNDISCOURAGED by the fate of the "ZR-2," built for us in England, and wrecked in August, 1921, on her trial trip; undeterred by the fatal smash of the semi-rigid "Roma," built for us in Italy and completely wrecked on what was to have been a short trial trip over Langley Field, Va., the United States navy is quietly going ahead with the building of enormous new rigid airships, capable of carrying scores of passengers on long distance flights.

Why?

Three New Dirigibles

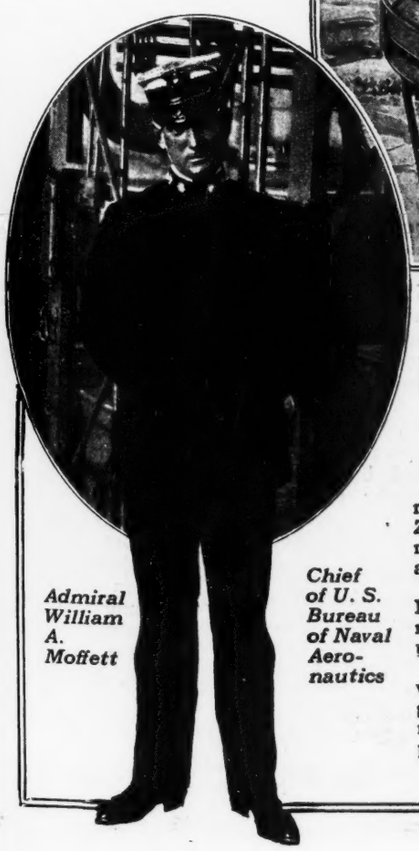
The general impression has been that the still recent disasters, including that to the "C-2" at San Antonio, meant the end of airship building, and that the future of air travel lay in the use of planes, rather than gas filled bags. Yet now the huge frame of the "ZR-1," the first rigid airship ever constructed in America, is rising toward completion at Lakehurst, N. J.

Meanwhile, construction of the "ZR-3," another rigid of a purely commercial type, is to be carried on for us in Germany; the semi-rigid "J-1," especially designed for the use of helium gas, is under construction; and, finally, at Lakehurst and at Belleville, Ill., are being completed airship hangars of tremendous size. Moreover, the world's tallest mooring mast, of unique design, constructed without guy wires, and containing an elevator to carry passengers to the embarka



Below, the international standard mooring mast for airships, with passenger elevator and embarkation stage. The world's biggest mast of this type has been constructed at Lakehurst, N. J. The huge rigid airliner, to be built for our government in Germany, will undoubtedly make its first American flights with passengers from this "aerial dock"

Fifty or 100 passengers, or even many more, according to the ship's size, will find luxurious cabins and wonderful views, as shown above, in coming airliners, of which our new naval dirigible, "ZR-1," is a forerunner. This picture of the promenade deck is from engineers' actual plans



Admiral William A. Moffett

Chief of U. S. Bureau of Naval Aeronautics

Why the Navy Believes in Commercial Airships

ADMIRAL WILLIAM A. MOFFETT, Chief of the United States Bureau of Naval Aeronautics, explaining, in an exclusive statement to POPULAR SCIENCE MONTHLY, the navy's purpose in doggedly developing the rigid airship, in the face of three recent disasters, lends weight to the belief that Zeppelin type, passenger-carrying airliners, rendered safe by the use of helium gas, are to be a reality in the near future. He says:

"After the war, the General Board of the Navy recommended that we go ahead with two rigids—the 'ZR-1,' here, and the 'ZR-3,' due to us from Germany.

"By keeping accurate cost data, we felt that we could determine the commercial utility of great airships. The 'ZR-1,' when finished, will make trips across the continent, to show the practicability of rigids for commercial use.

"Development of the mooring mast, since the war, making it possible to anchor the rigid for weeks at a time without damage, and insuring safe embarkation for passengers, adds greatly to the commercial future of these airships. The masts can be erected for $20,000 or $30,000, including passenger elevators. They can be placed in cities, or any other place where needed, and are economical substitutes for the huge sheds costing over $1,000,000.

"We believe strongly that rigid airships may be of great commercial value. Compare them with the railroads. They do not use tracks, roadbeds, way stations or any of the related paraphernalia, nor do they require personnel for maintenance of way. Power plant and Pullman combined, they have the free heavens for right of way.

"If the Uni ed States did not go ahead with the 'ZR-1' and the 'ZR-3,' world progress in aerial transportation would be set back one or two generations."

Safe in Port!

DOCKING at tall mooring masts, the air leviathan now predicted by aeronautical experts will weather storms safely, and will be free from the perils that have wrecked dirigibles entering and leaving the old-style Zeppelin sheds. Terminals like this can be located close to the centers of big cities, while the old hangar had to be in the open suburban fields

tion platform, 136 feet above the ground, has been completed at Lakehurst.

What can be the purpose of the government in developing these mammoth and apparently unwieldy ships after so many disasters? Why are we building colossal mooring masts and hangars for them?

The answer is that authorities in Washington believe the use of helium gas will obviate accidents like those that wrecked the "Roma" and the "C-2," while the use of mooring masts instead of sheds will lessen other perils.

Better Transportation

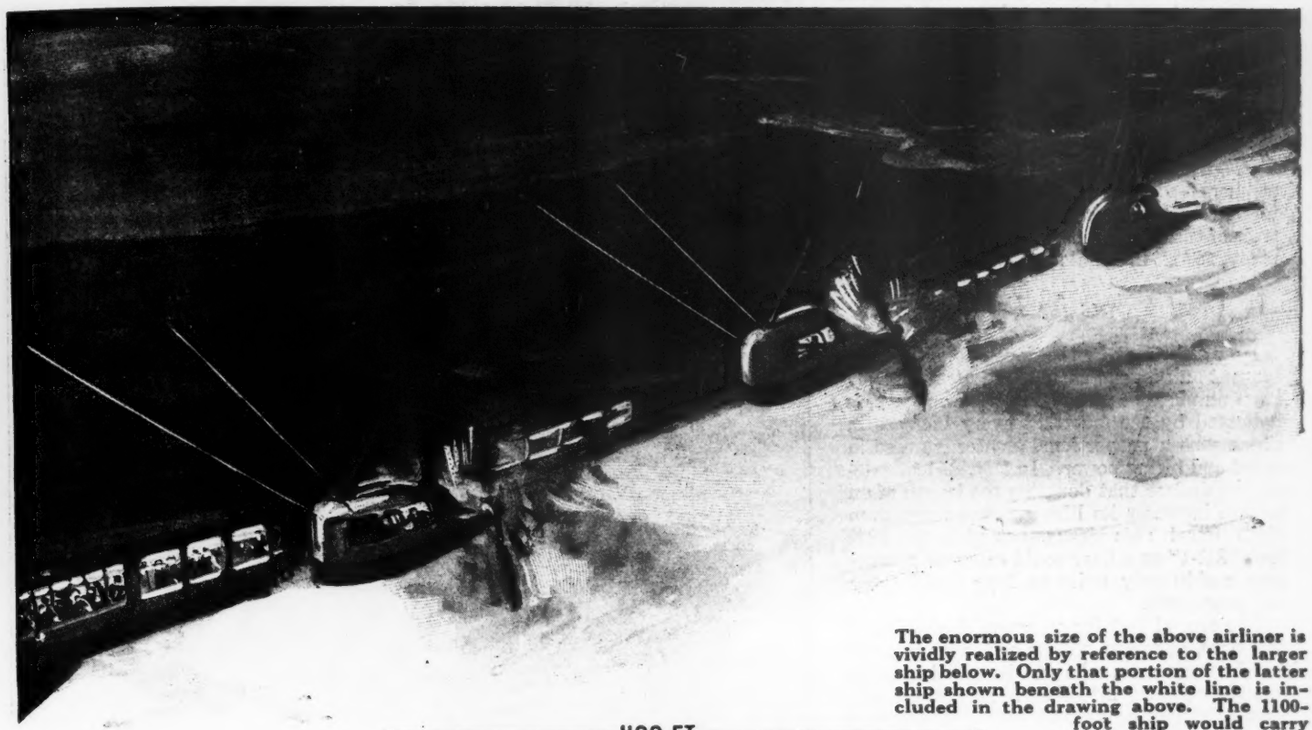
Also, back of the navy's plans is the desire to foster the development of great passenger airliners in this country in the near future, and the belief that they will prove commercially practical in transcontinental travel. Experts will tell you that rigid airships are bound to bring us faster, more economical, more comfortable and more healthful means of transportation. Indeed, one national authority—A. Leo Stevens, instructor of aeronautics for the United States army at Scott Field, Ill.—predicts that a large proportion of the people in the United States will soon be flying in dirigibles ranging in size from the small "flivver" type to mammoth ships driven by from 10 to 20 motors.

Some Features of Airship Travel

As to the comfort and ease with which we may travel by airship, we need refer only to the records of what has been accomplished in this respect. In the airship of the future, ample accommodation for passengers, both during the day and night, will be provided. These travelers will sit facing each other, with a table between them, as in a large Pullman car. They will be able to move about almost at will. Sleepers will resemble those of our Pullmans. And, according to the reports of Lieutenant-Commander Maitland, who piloted the "R-34" on her famous trip across the Atlantic, and of all who have likewise experienced the thrill of traveling by airship, the passengers sleep uncommonly well, while the smooth, exhilarating motion gives more delight than any other mode of transportation.

Accommodations for observation—and in this respect air travel excels; for keeping warm in the colder atmospheres above the earth; for lounging and for dining, offer promise of the most luxurious form of travel we have ever known.

The development and operation of the "ZR-1" naturally holds first interest, because of the imminence of its completion, and because it is evidently the forerunner of still greater airships to be constructed later. This first monster rigid airship to be built in America not only will be fitted with the first American airship engines, but will



The enormous size of the above airliner is vividly realized by reference to the larger ship below. Only that portion of the latter ship shown beneath the white line is included in the drawing above. The 1100-foot ship would carry 400 passengers on a cruise of 5000 miles, together with baggage and mail; while the "ZR-1" would carry only 50 passengers

Engineers' figures show that a ship less than twice as long as the "ZR-1" (note above diagram) would increase its lifting capacity 8 times

use American duralumin in its construction. One of the largest rigid airships ever completed, it will have a content of 2,115,174 cubic feet of gas, a length of 680 feet, a height of 93 feet, and a diameter of 78.8 feet. In seven cars hanging from the great keel of the vessel will be located the navigation, radio, and propelling mechanisms. Six of the cars will contain Packard airship engines of 300 horsepower, capable of 1400 revolutions a minute. The 20 bags, to be filled with either helium or hydrogen gas, will be of cotton lined with goldbeaters' skin, for which the skins from 500,000 head of cattle will be utilized.

With a framework of duralumin — a composition largely consisting of aluminum—the "ZR-1" will be manned by a crew of 23 and will be capable of lifting 40 tons, besides her own structural weight of 30 tons. The airship will be able to travel 9000 miles without replenishing her fuel. She will have a cruising speed of 50 miles an hour, and a top speed of 75 miles an hour.

The Lakehurst shed, specially built to house the "ZR-1," will be the largest in the world —so vast, in fact, that two United States Treasury Buildings could be placed one on top of the other under its roof, and the flagstaff of the second would not touch the ceiling. Again, if the Treasury Building were placed at one end of the shed, there would still be room for a baseball diamond. The shed will house two larger ships than the "ZR-1."

In the "ZR-3," to be constructed for Uncle

Rigid Airship Commercially Practical, Says Zeppelin Expert

"THE rigid airship is at this moment a practical means for air service between America and Europe, offering passengers about the same conveniences as a Pullman train at an expense no greater than that on an ordinary steamer—perhaps less, when it is considered that the time consumed in a voyage is cut in half. There is a commercial need for the airship that the airplane does not fill And there are rewards for those who recognize and meet this demand"

Such is the statement given exclusively for POPULAR SCIENCE MONTHLY readers by Dr. Max Munk, former aerodynamic expert of the Zeppelin Company; and now employed by the U. S. National Advisory Committee on Aeronautics as technical assistant to the committee of experts that is studying the design of the "ZR-1." Doctor Munk is probably in closer touch with the actual achievements of rigid airships than any other man in America.

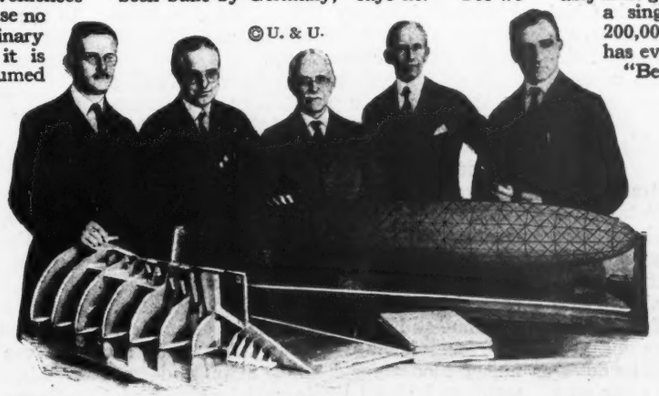
"More than 100 practical rigid ships have been built by Germany," says he. "Yet we are only at the beginning of airship development. The larger the ship becomes, the more economical it is. Safety probably is as great as with a steamship. Not a single passenger of more than 200,000 carried by Zeppelin airships has ever been injured.

"Besides carrying greater loads than the airplane, the airship can remain much longer in the air.

"The size of rigids during the war was limited by the sheds in which they were constructed and housed.

"The structural problems are merely problems for the engineer. An airship, like a house or bridge, if properly designed and manufactured, is strong enough to fulfil the purpose to which it is put.

"The fire hazard is negligible. No German airship was ever burned in the air save by enemy action. One ship was even struck by lightning and no injury resulted."



Committee of America's foremost aeronautic engineers studying model of the dirigible "ZR-1." They report their findings to the National Advisory Committee on Aeronautics. Left to right: W. Watters Pagon, Baltimore, Md.; Dr. L. B. Tuckerman, U. S. Bureau of Standards; Henry Goldmark, chairman, New York City; Professor William Hovgaard, Boston, Mass., and Dr. Max Munk, technical assistant, formerly of the Zeppelin Company

Sam by Germany under the Reparations Agreement, may be expected the real development of the airship for commercial use. While its completion is not so immediate as that of the "ZR-1," the Navy Department has announced that the "ZR-3" "will be of the purely commercial type, and that it will be used on an experimental passenger line." This—the first of America's future passenger airliners—will represent the last word in foreign airship construction, and representatives of this country have already left for Germany, to "sit in" on its construction.

Great Chance for Development

How swift may be the development of subsequent airliners, capable of transporting large numbers of passengers, with baggage, is indicated by the fact that every increase in size means a proportional greater increase in speed and lifting power. In fact, dirigible designers declare that doubling the length of an airship increases its lifting power more than eight times! This means that while the 680-foot "ZR-1" as a liner could carry 50 passengers, a ship only twice as long could carry 400 passengers.

The crucial test for commercial airships of this type, of course, will be action by bankers and business men, who will be called upon to put their money into them. In this connection, it is significant that a commercial airship company is already planning to acquire three airships, each twice the size of the "J-1." Inquiries from this and other organizations of business men concerning the immediate commercial possibilities of the airship, recently led to an extended investigation by engineers, followed by a definite plan for putting into commercial service at least one of these new giants of the air. One of the leaders in this enterprise has been Fred S. Hardesty, Washington representative of the General Electric Company, who is associated with a number of nationally known men in the formation of a great system of airship routes.

"Commercial air navigation is no longer a subject for speculation," Mr. Hardesty told me. "It is a present practicality. The luxury, economy, safety, and volume of airship transportation in Germany before and after the war are startling, when one is confronted with actual facts regarding the enterprise.

"America, with her far-flung territories and insular possessions, with her commercial possibilities in Central and South America, and with her centers of population demanding more rapid transportation, is nature's chosen spot for civil airship navigation. Another year should see transcontinental airship routes under way, if not in actual operation."

Major-General Mason M. Patrick, Chief of the United States Army Air Service, explaining the development of the rigid airship in the face of difficulty and mishap, offered this statement:

What the Future Holds

"We foresee dirigible airship transportation—civil and military—immediately. We feel that we already have the knowledge and experience to produce equipment. We see clearly enough ahead to warrant us in exerting every possible effort in airship construction, taking advantage of what we already know. New possibilities and new uses for lighter-than-air craft will be determined, and new equipment will come as a matter of course."

Further revelations of the farseeing plans of the United States navy and army, showing the way toward commercial use of the airship, are contained in statements, accompanying this article, by Dr. Max Munk, onetime aerodynamic expert of the Zeppelin Company, and now of the United States National Advisory Committee for Aeronautics, and by Admiral William A. Moffett, of the United States navy.

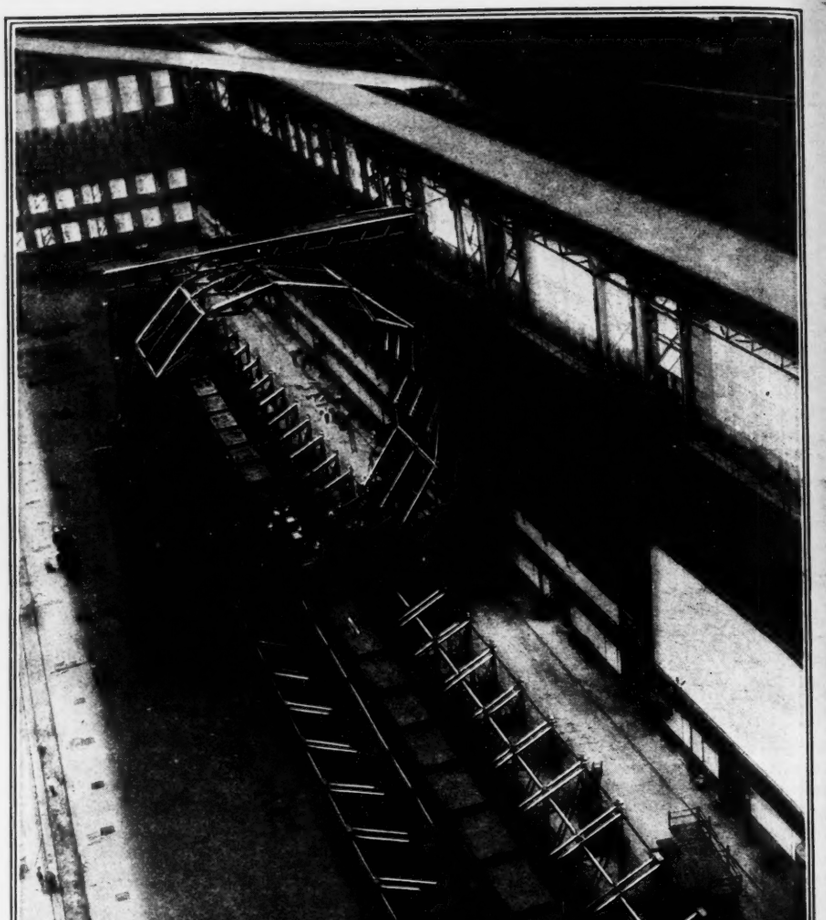
As evidence that the entire world is alive to the immediate possibilities of commercial air travel by means of the rigid airship, an international conference, at which the United States was represented, was held this year in London. The purpose of the meeting was to standardize the fittings and docking signals for airships. Mooring masts, it was decided, are to be fitted with standardized "wharf" tops, to receive the conical bow of any airship of any country. Gasoline and gas lines are to be of uniform size for refueling. Other items, such as pulley blocks for hauling airships downward, and signal lights, will be standardized. Furthermore, a Spanish company has announced immediate establishment of a transatlantic airship service from Seville to Buenos Aires.

Answering the sweeping criticisms of dirigibles as a class, aroused by the wreck of the "C-2" and the appalling loss of life in the disaster to the "ZR-2" in England and to the "Roma" in the United States, the Bureau of Aeronautics of the Navy Department has this to say:

Pioneering Involves Risks

"The Bureau thoroughly appreciates the fact that it is essential to insure safety of operation in handling rigid and semi-rigid airships, but it is strongly of the opinion that the construction of the 'ZR-1' should be proceeded with, in order that a proper development of the lighter-than-air art may go hand in hand with the development of heavier-than-air art. Pioneering in any art involves the expenditure of brains and a certain amount of risk."

Soon after the completion of the "ZR-1," we may expect the possibility of traveling by airship safely, at a speed greater than we have ever known, with much more comfort, and with far more economy of time and expense.



World's Largest Airship Hangar to House "ZR-1"

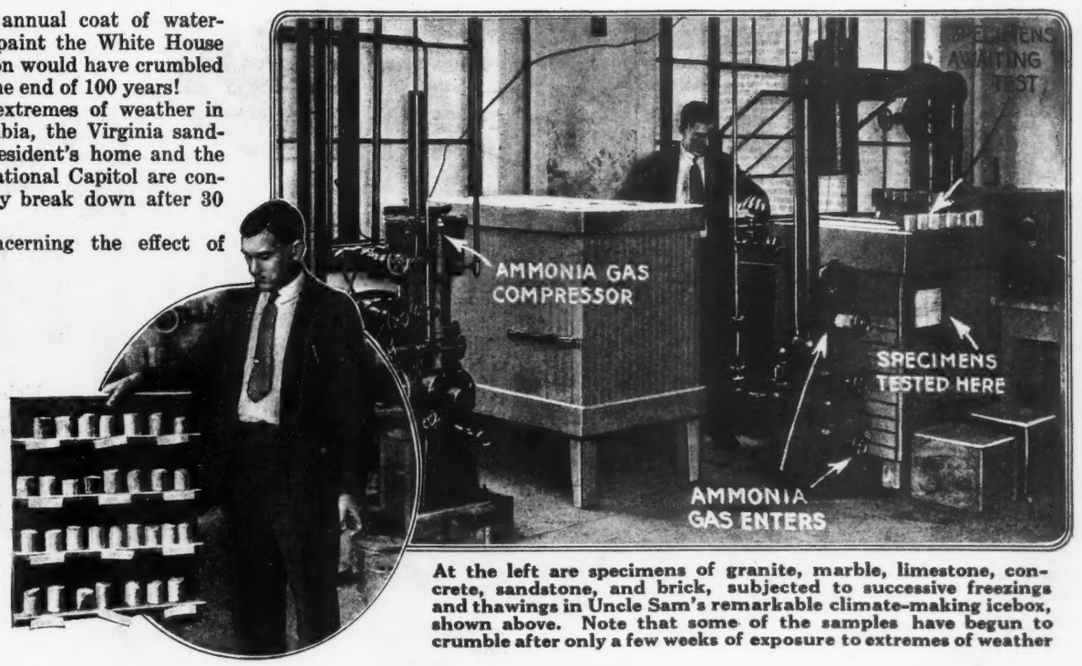
THIS remarkable photograph of the vast shed at Lakehurst, N. J., built especially for the "ZR-1," shows a section of the huge ship's frame rising on the immense cradle constructed for it. So spacious is this hangar that two buildings the size of the United States Treasury could be placed, one above the other, within its walls, without touching the ceiling!

Building Stone Tested in Government "Ice Chest"

WITHOUT an annual coat of waterproof white paint the White House at Washington would have crumbled to a mass of ruins at the end of 100 years!

Unprotected from extremes of weather in the District of Columbia, the Virginia sandstone of which our President's home and the original part of our national Capitol are constructed would quickly break down after 30 or 40 years.

Startling facts concerning the effect of climate and temperature on building materials, have recently been revealed by tests conducted in a remarkable icebox devised by Dr. D. M. Kessler of the United States Bureau of Standards in an attempt to standardize building specifications for the various sections of the country, and to minimize present risks in construction. In a few weeks' time, this extraordinary refrigerator reproduces all the climatic variations that would be encountered in any given locality during a period of 25 years.



At the left are specimens of granite, marble, limestone, concrete, sandstone, and brick, subjected to successive freezings and thawings in Uncle Sam's remarkable climate-making icebox, shown above. Note that some of the samples have begun to crumble after only a few weeks of exposure to extremes of weather

The fact that a material that wears exceptionally well in one climate may deteriorate in another has long been recognized. Cleopatra's Needle, the famous Egyptian obelisk now standing in Central Park, New York, withstood centuries of Egyptian weather, yet began to deteriorate as soon as it was brought to this country.

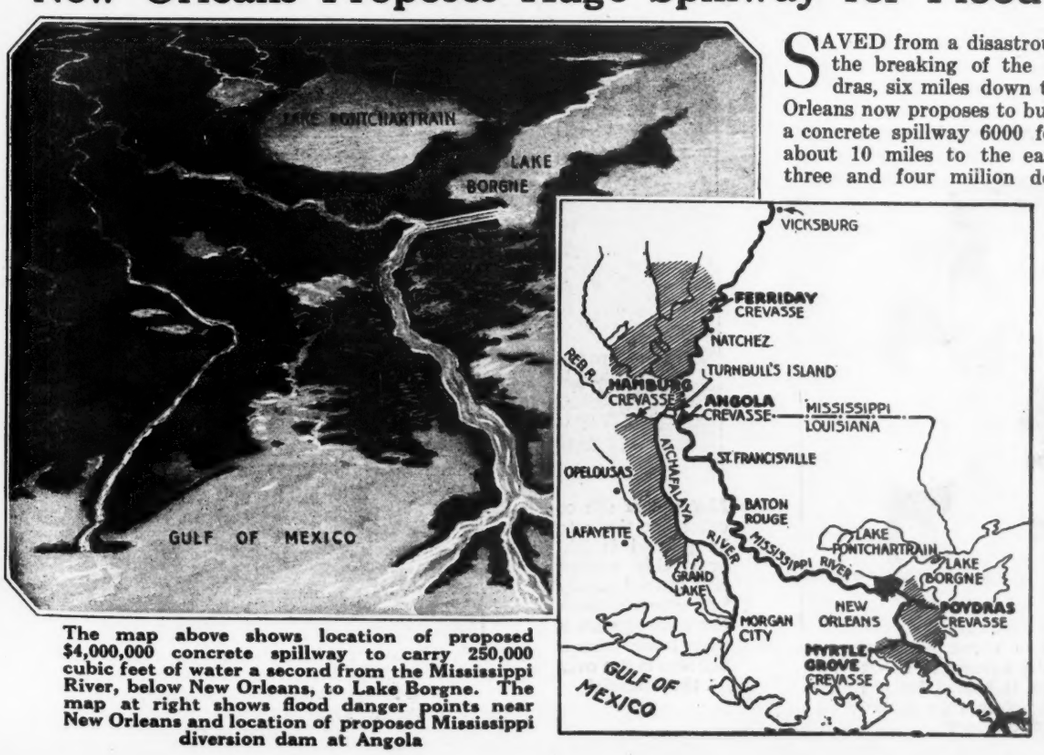
The causes of rock deterioration are interestingly revealed by the tests. When rock is relatively dry, it is not greatly damaged by exposure to freezing. But when it is watersoaked, as by continued rains, the pores of the material are full of water that expands as it freezes. This expansion strains and breaks the material.

Ammonia Cools Test Tanks

The ice chest consists of three sheet-iron tanks, one inside the other, and all insulated by a wooden covering with cork lining. Specimens of stone to be tested are placed on trays in the inner tank. Coils of pipe surrounding the tank conduct ammonia for cooling the tanks.

Alternate periods of freezing and thawing inside the chamber are governed by a simple pail-tilting scheme. Two drip buckets are hung on the ends of a balanced beam. These ends are connected with valves, one of which controls the flow from a water supply, the other controlling the flow of ammonia into the cooling apparatus. When the buckets are in one position—one up and the other down—the ammonia valve is open and the test chamber is subjected to freezing conditions. When the position of the buckets is reversed, the water valve is open and water fills the chamber, subjecting the specimens to raining and thawing conditions. By regulating the drip from the lowered bucket, experimenters can regulate the length of a freezing, thawing, or raining period.

New Orleans Proposes Huge Spillway for Flood Protection



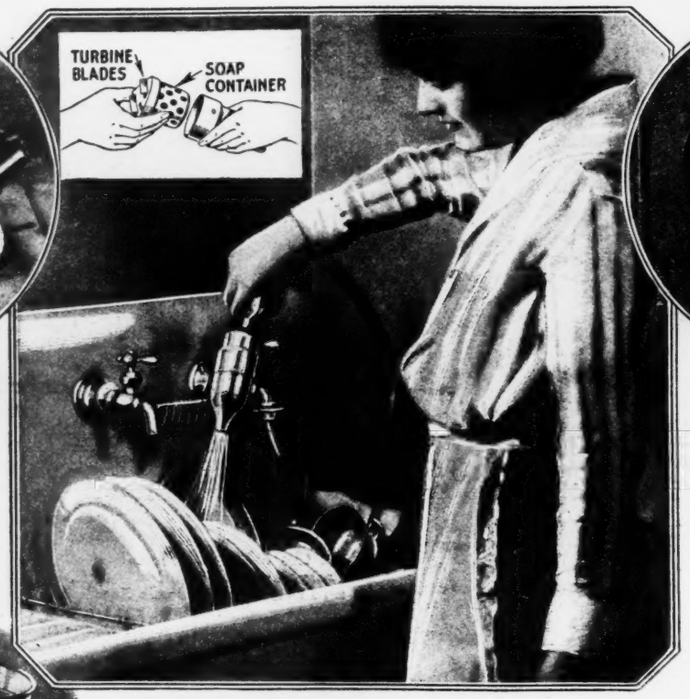
The map above shows location of proposed $4,000,000 concrete spillway to carry 250,000 cubic feet of water a second from the Mississippi River, below New Orleans, to Lake Borgne. The map at right shows flood danger points near New Orleans and location of proposed Mississippi diversion dam at Angola

SAVED from a disastrous flood last spring only by the breaking of the Mississippi levee at Poydras, six miles down the river, the city of New Orleans now proposes to build at the site of this break a concrete spillway 6000 feet wide to Lake Borgne, about 10 miles to the east, at a cost of between three and four million dollars. This step is the culmination of growing dissatisfaction with the Mississippi levee system and comes as a practical demonstration of the contention, advanced in an article in the October issue of POPULAR SCIENCE MONTHLY, that spillways afford more protection from dangerous water pressure.

Another proposal for solving a serious flood problem at Turnbull's Island, where the Mississippi, Atchafalaya and Red rivers come dangerously close together, is the building of a dam across the Mississippi just below Angola, to divert nearly all the excess water in floodtime into the Atchafalaya.

Turbine Dishwasher Leads the Month's Household Inventions

Dust swept or brushed into this dustpan, drops into the deep trough at the handle end of the pan and cannot fall out unless the receptacle is turned



When this dishwashing device is attached to the hot water faucet by a rubber tube, the force of the water, acting on the turbine blades of a perforated soap container rotates it, and the hot, soapy water effectively cleanses the dishes

Noise produced by the slamming of doors can be prevented by a new silencing device consisting of a thick rubber pad placed over the lock part of the door and held in position by elastic rings

Designed for the bachelor who likes to prepare an occasional cup of coffee, this new device consists of a strainer with exchangeable silk cloth which holds the coffee while hot water is poured over it

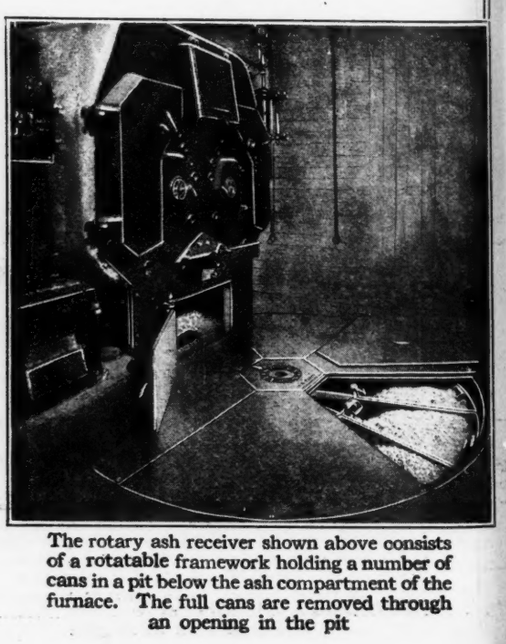
Refined petroleum poured into the reservoir of this broom oozes through fine openings in the bottom of the reservoir and moistens the bristles, causing them to hold the dust removed from floors or carpets

To prevent the slipping of a jar while a tight lid is being unscrewed, the jar may be fastened in a specially designed vise clamped to the table

Turning a thumbscrew in the top of the shaker shown at left revolves small knives that scrape the crust of salt obstructing the holes inside the shaker cap

The drying cabinet shown above will dry laundered clothes from the wringer in about 30 minutes. The cabinet is heated by gas and combustion is so complete that a flue connection is unnecessary

Material of silk or other fine tissue to be pleated is laid over this pleater and pushed evenly into spaces between the grating with a silver knife. Then a hot iron is run over the material



The rotary ash receiver shown above consists of a rotatable framework holding a number of cans in a pit below the ash compartment of the furnace. The full cans are removed through an opening in the pit

Statues of Concrete and Woven Wire

How remarkable sculptor molds cement and sand

CONSTRUCTION of hollow concrete statuary, in which a plastic mixture of cement and sand is molded upon a framework of piping and woven wire, is a new departure in the art of sculpturing devised by T. A. Brouwer, of Pinewold Park, Westhampton, L. I.

The sculptor first constructs a base framework of galvanized iron pipe and upon this fastens quarter-inch galvanized iron wire mesh to conform to the general contour of the statue. Upon this wire he packs his concrete and molds the figure from the bottom up so that it will be able to carry its own weight while the concrete is hardening.

The average thickness of the finished shell is one inch and it is very hard after setting, the concrete mixture being made of 1½ parts sand to one part cement. Various finishes are obtained by adding coloring material to the cement.

This new method of modeling in concrete opens a wider field for architectural adornment of buildings, since it is light and durable, and can be carried easily to any height demanded by the work in hand.

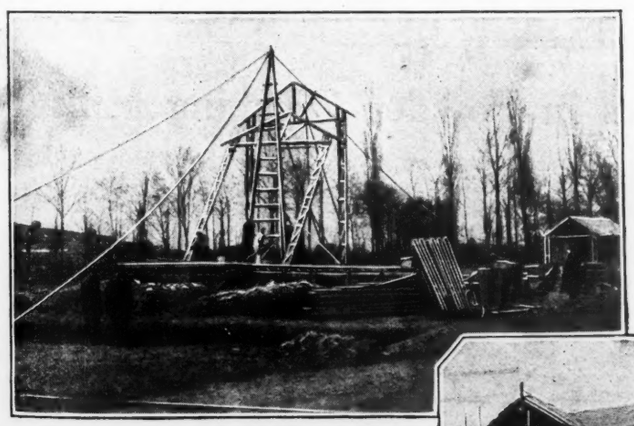
MOLDED of concrete on a framework of woven wire and piping, this remarkable statue representing a soldier planting the American flag in France, was recently completed by T. A. Brouwer at Eastport, L. I. The pedestal is part of a globe 15 feet in diameter formed of cement reinforced by wire supported on iron piping. The figure is life size, while the flag seen at the left before application of the concrete, is eight feet high

Straw Houses in Devastated France

STRAW houses, warm, comfortable, and waterproof, are making their appearance in the devastated regions in France, as the result of the high cost of other building materials. They are constructed at about half the cost of the usual frame houses. Straw of any kind is cut into small bits with revolving knives, crushed on steel rollers, and then compressed by heavy hydraulic presses into blocks about 18 inches square in cross section, and of any desired length. The blocks look like very coarse, compact cardboard.

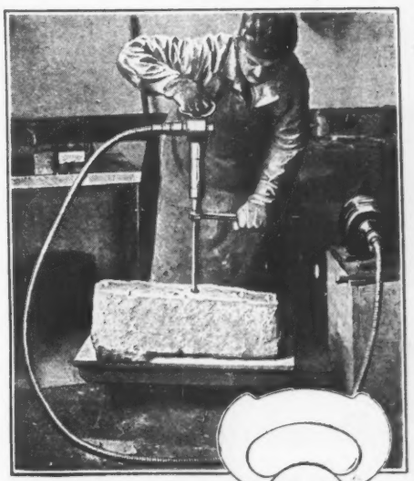
Since the weight of the straw blocks is only one tenth that of brick or stone, the houses do not require heavy foundations. A light framework of studs is erected, and blocks of compressed straw are used to fill the spaces between the beams. Door and window frames are provided in the usual manner. To prevent the straw blocks from absorbing water from the ground, a layer or more of tar paper is placed between the foundation and the first layer of blocks.

The straw walls are coated with stucco, plaster, or plain whitewash on the inside and the outside to protect them from the weather and to improve their appearance. Tests show that these straw blocks are an excellent insulation against heat and cold.



The framing of a "straw" house, which carries all the stresses, is put up in sections, as shown at the left, while the compressed straw bricks are used as filling for walls and partitions and are fitted in the framework as below

DID you know that annually in the United States 83,000 dwellings are burned with 15,000 lives lost? Read in next month's issue, how you can make YOUR home fireproof.



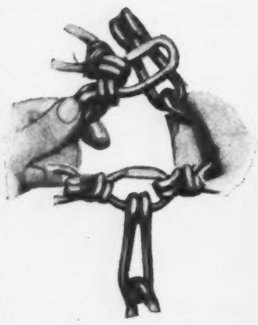
Electricity Drives Pneumatic Tool

AN EXTRAORDINARY pneumatic tool recently developed contains its own air compressor, operated by an eccentric deriving its power through a flexible shaft from an electric motor. The simple construction of the tool is shown in the diagram. It is manufactured in six different sizes, varying from a delicate tool for engraving, metal chasing and light hammering, to a heavy tool for metal chipping, rock drilling or riveting.

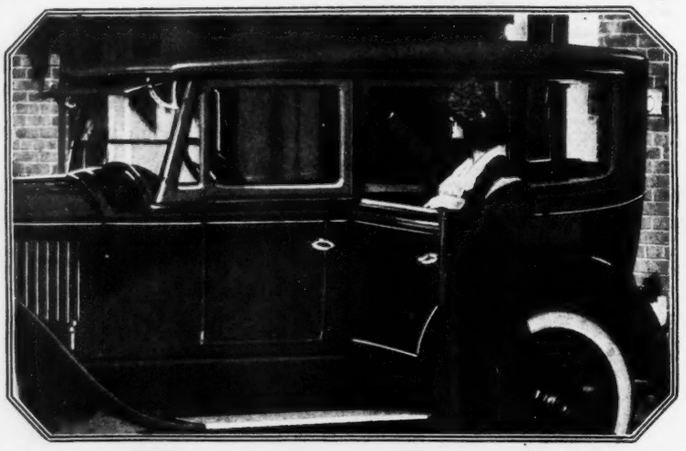
On the down stroke, the piston, connected by a ball joint with an eccentric rod, compresses the air in the cylinder and drives the reciprocating hammer downward against the shaft of the tool. On the return stroke, the suction of the piston draws back the hammer, but the air in the cylinder forms a cushion between the tool and the piston. The hammer is capable of delivering from 1800 to 5000 blows a minute.

Will Oil Replace Coal in Our Furnaces?

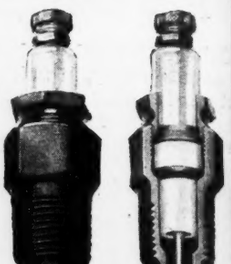
Quick Change Auto Top—Other Useful New Accessories



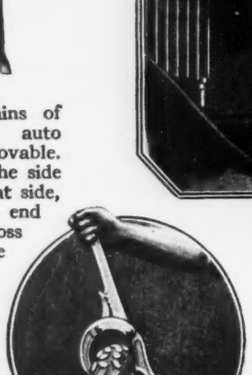
The cross chains of this anti-skid auto chain are removable. Each link of the side chains has a flat side, over which the end hooks of the cross chains can be slipped



Sliding glass panels, suspended from tracks, move to the rear of this new auto top, converting the closed car into an open car. The panels are freed by a lever

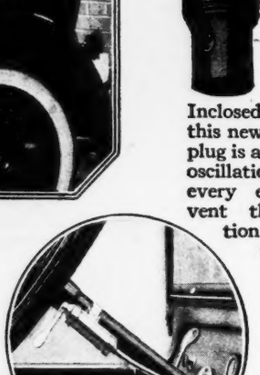


Inclosed in the base of this new type of spark plug is a small ball, the oscillations of which at every explosion prevent the accumulation of carbon in the plug

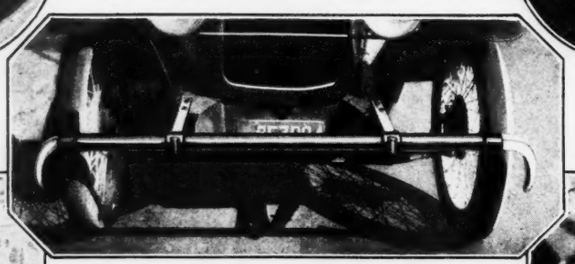


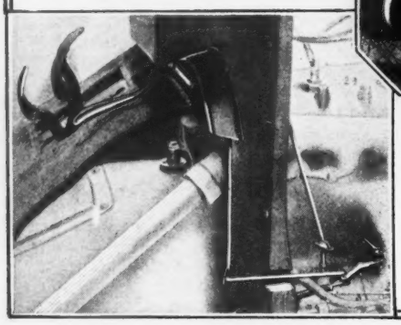
Automobile tires can be quickly removed with a new tool consisting of an iron bar and a pivoted hook, shaped like a horseshoe, which is placed around the tire

The fender bar shown below serves as an automobile lock when horns at ends of the bar are turned upward and locked, making it impossible to steer the car



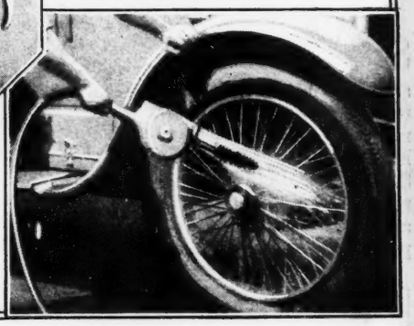
This ingenious headlight control switch, placed directly under the steering wheel within easy reach, permits the driver to regulate his lights without removing his hands from the wheel





Mounted on the dash entirely independent of floorboards and motor, a new foot accelerator for Fords (at left) cannot become jammed in floor boards or mat

Used with any garden hose, the mechanical automobile washer (at right) has a revolving brush driven by water power at from 300 to 400 revolutions a minute



Bombproof Shelters Save Lives in Powder Crushing Mills

LOSS of life from explosions in the dangerous corning or powder crushing mills of black powder plants has been largely eliminated in the plants of the E. I. Du Pont de Nemours & Company by the construction of bombproof shelters in which workmen operate the mills from a safe distance.

Controlled by Levers

In the corning mill, cakes of pressed powder are crushed into granular form by passing between pairs of metal rolls in the corning mill. The workman charges the mill with powder and then goes to the shelter, 50 yards from the mill. The shelter is equipped with levers with which he starts and stops the electrically operated machinery. Through a small aperture the operator watches the machinery of the corning mill. The mill itself has an electrical mechanism that automatically stops the mill if any foreign substance finds its way to the rollers. The shelter house is about six feet square, all parts being constructed at least six inches in thickness.

These two safety devices have succeeded in eliminating loss of life in nine corning mill explosions that have occurred at various powder plants since their installation.

In a bombproof shelter at a safe distance from the corning mill, the operator controls with levers the electrically driven powder crushing machinery

Bean Pests Spreading

AS WAS predicted in an article in POPULAR SCIENCE MONTHLY last April, Mexican bean beetles are causing increasingly heavy damage to our bean crops.

Reports of the United States Department of Agriculture say that the beetle has infested 24 new counties in Georgia, Kentucky, Tennessee, North Carolina, and South Carolina.

Will Oil Replace Coal in Our Furnaces?

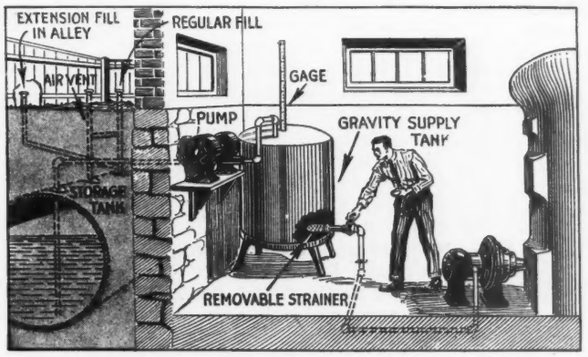
Here Are the First Accurate Facts Showing Advantages and Disadvantages of Converting the Dirty and Costly Coal Furnaces in Our Homes into Oil Burners Such as Are Now Heating Skyscrapers

By F. A. Platte

WHAT are the chances of a neat, economical oil-burning furnace replacing in our basements, for heating purposes, the dirty coal burners we use today?

Alluring pictures of a revolution in home heating methods, following the development of economical oil-burning installations, have been presented to us in recent months, and have caught the public eye all the more vividly because of the coal crisis. We know that ships are being rapidly converted from coal to oil burners, and that many great office buildings have adopted oil burning installations this present year.

Will our homes be the next?



A typical installation of an oil burning heating system for the home is shown above. The equipment includes oil storage tank, gravity supply tank, pump and automatic heater installed through the ash door of the ordinary coal furnace

The fact that several hundred oil burners now on the market are being advertised as suitable for installation in domestic furnaces emphasizes this question in every mind. Yet it is estimated that much less than 1 per cent of the homes in the nation have so far adopted this new method of heating. It is the purpose of this article to give interested home owners the first accurate picture of the actual advantages and disadvantages of conversion from coal to oil burning in the home.

That oil, if used in a proper apparatus, will produce more heat to the dollar of cost than coal, is the claim made by oil men and conceded by engineers. In the present types of small oil burners efficiencies of 50 per cent have been obtained, whereas coal burners are rarely more than 25 per cent efficient when fired by the layman. Taking present prices of oil and coal, it is safe to say that a home requiring 10 tons of coal a winter would be heated by oil at a cost of $20 less than the coal would cost. For other homes the saving would vary, in proportion to the number of tons of coal normally used.

This saving appears to be offset, however, by the initial expense of installation of an oil burner. Although the same coal furnace is used, yet from $250 to $600 must be expended, at present, for the burner,

Advantages of Oil Heating and What It Will Cost You

By W. C. McTarnahan, Vice-President, Petroleum Heat and Power Company

YOU have, no doubt, been wondering recently whether burning oil in your furnace, instead of coal, would have advantages in the home similar to those proved for it in big buildings and ships. Without studying the engineering problems, you can appreciate the apparent advantages of oil burning, namely: that heat can be obtained at a lower price; that oil can be handled more easily than coal; that it means a cleaner furnace room; that it eliminates ashes, and requires less storage space.

In the great Metropolitan Tower, New York City, Mr. McTarnahan (inset) has just installed an oil burning heating system

These facts have been among the reasons prompting oil burning installation in some of the largest buildings and department stores in the country. In New York alone, the great Metropolitan Tower, the Ritz Carlton Hotel, John Wanamaker's, Mount Sinai Hospital, Columbia University, R. H. Macy's department store and many other hotels and buildings have just adopted oil burning systems. Throughout the country, numerous other installations are even now being made.

But up to the present time there has not been a parallel development in the use of oil in our homes. Naturally, the oil burning engineer has given his first efforts to important buildings, and here has proved the success of the new system. Recently, however, residence oil burners have been developed. They offer you the opportunity of successfully burning oil in the same furnace in which you are now using coal.

Our Oil Supply

Some home owners hesitate to adopt the new system through fear that oil may be hoarded, and a higher price demanded later on. A moment's thought will show that this is impossible. The annual production of fuel oil is already enormous. The annual supply is like a continually rising river, which cannot be dammed. Since it cannot be stored, it must be marketed, and at a price to compete with coal.

In certain localities, coal may temporarily be cheaper than fuel oil, but this condition cannot become general, by reason of the large quantities of fuel oil that must continue to be thrown on the market. Those who are today burning oil are doing so because it saves them money. The fact is that fuel oil is a direct competitor of coal, and it cannot be beaten in competition. Producers of fuel oil are in a position, because of the lower costs of production, to undersell the coal producer all along the line.

But what about the permanency of the fuel oil supply?

To answer this question, we must go back to the potential supply of oil throughout not only the United States and Mexico, but the world. Petroleum is to be found all over the world, except in Australia. From Alaska, in the North, there is a string of oil wells down to the southwest tip of the American continent. At least a dozen states have given their names to big oil fields in this country, while there are great oil possibilities in 35 foreign lands. Just one of these foreign countries, Russia, treasures more oil in one comparatively small area than there is in the whole United States. And the United States' production in 1921 alone, was 475,000,000 barrels—more than half the world output. Geologists claim vast oil fields in South America are as rich as the Russian fields.

Surveying these facts, the house owner who contemplates changing from coal to oil need not fear that the oil supply may run out, or that the price of oil may become prohibitive.

But how much will oil fuel cost him today?

It is generally recognized that under normal conditions 125 gallons of oil will produce about the same amount of utilizable heat as a ton of coal, depending upon the make and size of burner. With gas oil at the present price of 8 cents a gallon, the relative expenditures would be $12 for oil and $14 for coal. Should the relation of prices remain unchanged, a saving of at least two dollars for every ton of coal now used would be effected, and it is entirely probable that the same or a better ratio will be maintained for some years to come.

oil tank, and installation. In some places where city ordinances are extremely severe, the cost may run as high as $1000. So, considering fuel saving only, it would apparently take considerable time for an oil burner to pay for itself.

Possibilities of the Future

There is good reason to hope, however, that increased public use and refinements in design and manufacturing costs will ultimately lower considerably the first cost of some of these appliances. Simple in operation, in improved types, easy to care for, quickly turned on and off, so that the fire is burning only when needed, the new system is so similar in its advantages to other household utilities, as electric light, that it seems almost certainly in line for widespread adoption.

A Western manufacturer of a new oil burner that is said to be unusually simple and efficient, makes the point that the system will appeal to individual owners of innumerable small establishments, like laundries, greenhouses, and hotels. With this system, it is claimed, the owner of a greenhouse, for example, can pay for his oil burner in less than a year from his savings in the cost of fuel, and still be ahead at the end of the season. Much of this saving is said to be due to the fact that the new oil burning equipment has eliminated expensive mechanical devices such as electric motors, pumps, and oil compressors that heretofore have been used for atomizing the oil and that have been largely responsible for the high cost of installation.

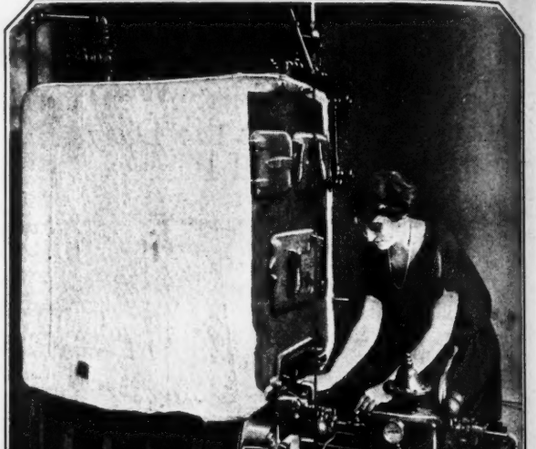
It is quite possible that such installations will be the intervening step between the present use of oil fuel in big buildings and its ultimate use in homes.

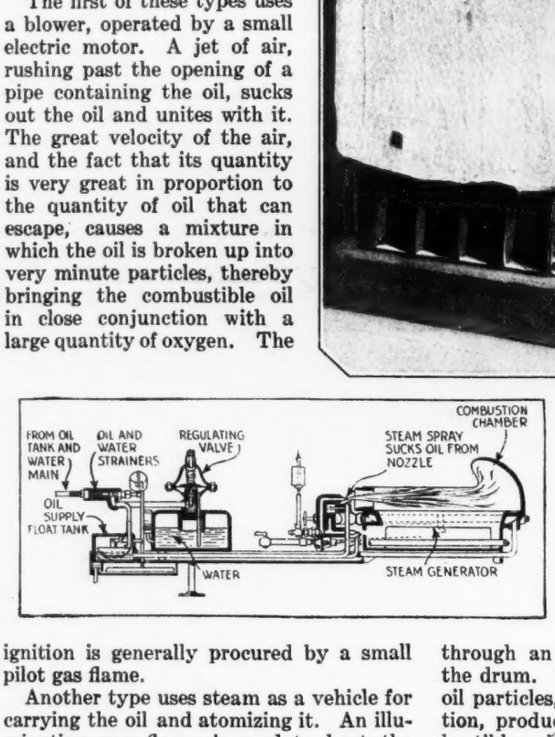
"Gas Oil" Used in Burners

The oil that is used is the so-called gas oil, a by-product constituting about six per cent of the products obtained from crude petroleum. At its present price of about 8 cents a gallon, it can be purchased wherever Standard Oil products are sold.

As to the burners themselves, there are three chief types, each of which is designed for the same end—to achieve a maximum burning surface for the oil. Each attempts to break the oil into minute droplets—to atomize and mix it with a sufficient quantity of air, so that complete combustion will be obtained in a short time.

The first of these types uses a blower, operated by a small electric motor. A jet of air, rushing past the opening of a pipe containing the oil, sucks out the oil and unites with it. The great velocity of the air, and the fact that its quantity is very great in proportion to the quantity of oil that can escape, causes a mixture in which the oil is broken up into very minute particles, thereby bringing the combustible oil in close conjunction with a large quantity of oxygen. The ignition is generally procured by a small pilot gas flame.





Steam Blower Type

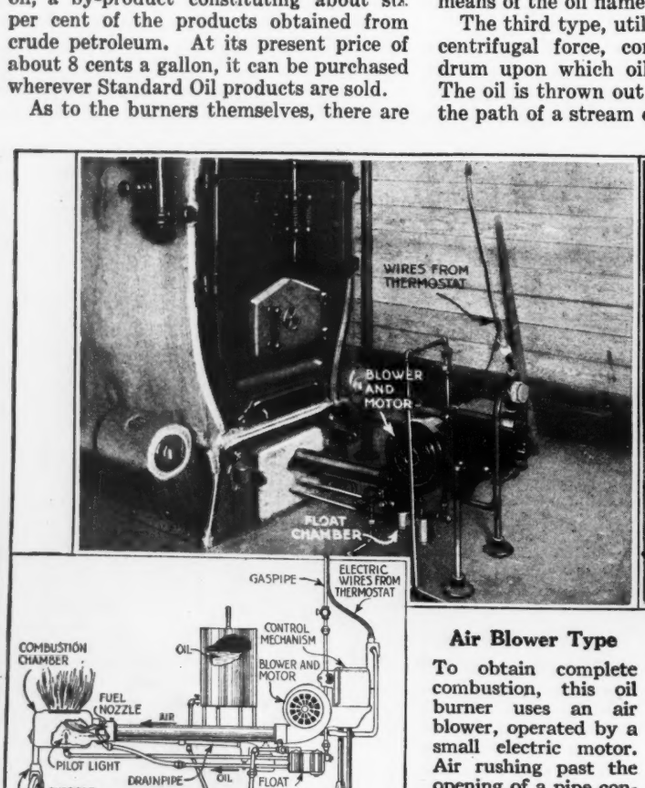
In this type of oil burner a steam spray causes the flow of oil to the combustion chamber and atomizes the oil. Steam is generated in a flash boiler below the oil flame, as shown in diagram at left

Another type uses steam as a vehicle for carrying the oil and atomizing it. An illuminating gas flame is used to heat the water in a flash boiler, until steam is procured. After a few minutes the steam starts to atomize the oil, as in the case of the blower type, and thereafter the burner is self operating, producing the steam by means of the oil flame.

The third type, utilizing the principle of centrifugal force, consists of a rotating drum upon which oil is allowed to drip. The oil is thrown out from the center into the path of a stream of air that rushes out through an annular opening surrounding the drum. The rush of air picks up these oil particles, and, completing the atomization, produces the properly refined combustible mixture.

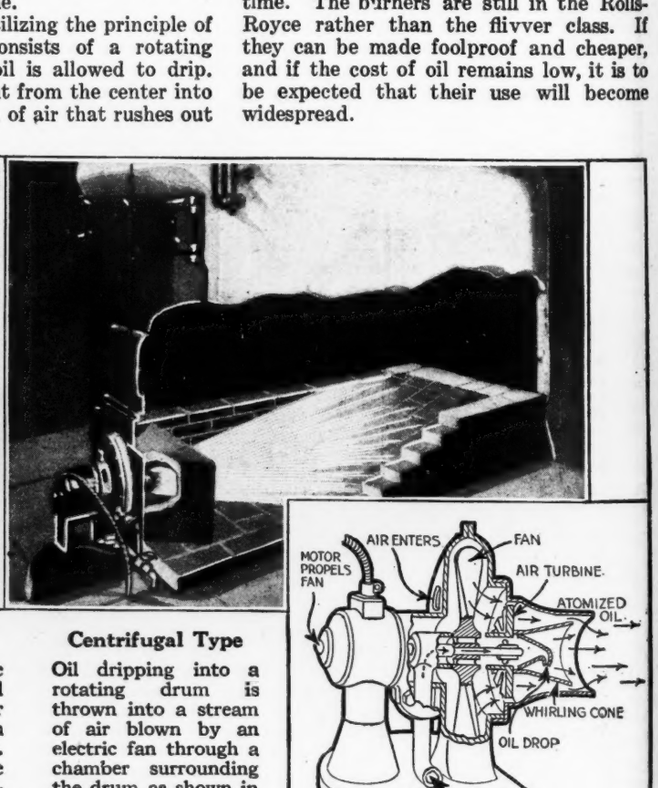
Will Oil Become Home Fuel?

Whether or not oil is the fuel of the future for the home can be answered only by time. The burners are still in the Rolls-Royce rather than the flivver class. If they can be made foolproof and cheaper, and if the cost of oil remains low, it is to be expected that their use will become widespread.



Air Blower Type

To obtain complete combustion, this oil burner uses an air blower, operated by a small electric motor. Air rushing past the opening of a pipe containing oil, sucks out the oil and atomizes it



Centrifugal Type

Oil dripping into a rotating drum is thrown into a stream of air blown by an electric fan through a chamber surrounding the drum as shown in diagram. This rush of air causes atomization

Jack Binns' Ten Commandments for the Radio Fan

Third Series: How to Get the Best Results with a Regenerative Receiving Set—Simple Hook-Ups and How to Make Them

By Jack Binns

THE regenerative radio receiving circuit was born to the world in 1912, out of the genius of E. H. Armstrong. To its proud parent it was a perfect angel in disposition and behavior, but now, at the age of eleven years, it still squeals and howls in the hands of the novice, unless handled with the utmost care.

To help the novice avoid these disturbances, it is my purpose, this month, to lay down 10 important rules, based on the experience of those who for years past have nightly walked the floor with Miss Regenerative Receiver, and have learned by bitter experience just how to humor her so that she will act as a perfect lady of radio should. Heed, therefore, the Ten Commandments for the Regenerative Receiver:

1. Keep the Feedback Simple.

If your sole desire is to listen to entertainment on the 360 and 400 meter wave lengths, you can make your own regenerative receiver very economically. All you need is a vacuum tube with socket and rheostat, one variocoupler and a variable condenser. Of course, telephones, grid leak, grid condenser, phone condenser, aerial, and the necessary batteries are required to complete the circuit. By using the simplest form of regenerative hook-up shown in Figure 3 on the following page, your receiver is reduced to two controls aside from the filament adjustment.

This most simple type of receiver will give excellent results if the following directions for hook-ups are observed carefully:

THE TUNING CIRCUIT is made by placing the variable condenser in series with the aerial, the primary of the variocoupler, and the ground connection. I have found that for the 360 and 400 meter waves, the tuning often can be done almost exclusively with the condenser, leaving a fixed number of turns in use in the variocoupler.

THE GRID CIRCUIT lead is taken from a point between the variable condenser and the variocoupler junction. This lead goes to the grid condenser. The other side of the grid condenser is connected with the grid terminal of the vacuum tube, both connections being made as short as possible. Shunted across the grid condenser you should have a high resistance leak of one megohm. The other side of the grid circuit consists of a connection between the positive terminal of the storage battery and the ground side of the variocoupler primary. The reason for this connection is that the positive side of the storage battery will attract the negative charge that accumulates on the grid and permit it to leak off through the high resistance. The grid condenser is in this circuit to permit the high frequency currents to pass through from the tuner to the grid without interfering with the function of the grid leak.

This Ingenious Desk Radio Set Built from POPULAR SCIENCE MONTHLY'S Blueprint

MOUNTED on a panel that fits into an old writing desk, this two-stage vacuum tube receiving set, constructed from POPULAR SCIENCE MONTHLY'S blueprint by Victor C. Beetow, of Elkhorn, Wis., is giving remarkably successful results. Its owner writes:

"The loudspeaker is bolted to a shelf attached to the back of the desk," says Mr. Beetow. "The B batteries—I use five of them of 22½ volts each—are on a shelf underneath the set. All wires come through the back of the desk.

"From the storage battery of my car parked just outside the house I obtain current for the three vacuum tubes and the loudspeaker, using a long piece of lamp cord attached with spring clips. Since I drive my car considerably, the generator on the car supplies plenty of current for both car and radio set, and so I never have a run-down A battery.

"Several persons have stated that my set brings in concerts louder than any other sets they have listened to."

Mr. Beetow is just one of scores of readers who have expressed their satisfaction with results obtained from sets built with the aid of POPULAR SCIENCE MONTHLY'S blueprint, which includes wiring diagram, details of construction and bill of materials.

To obtain one of these blueprints send 25 cents to the Blueprint Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City.

THE FILAMENT CIRCUIT consists solely of connections from the storage battery to the two filament connections of the socket. The rheostat should be placed in the negative side of the storage battery in order to give the filament greater positive potential with respect to the grid. This is important.

IN THE PLATE CIRCUIT, a wire should connect the plate terminal of the socket and one side of the variocoupler rotor. The other side of the rotor should be connected with one side of the telephones, while the other side of the telephones should be joined with the positive terminal of the B battery. Join the negative terminal of this battery with the positive terminal of the storage battery.

The set is now complete, with but two controls to adjust—the condenser in the aerial circuit for wave length, and the rotor of the variocoupler for regeneration. With the first control you get resonance with the transmitting station and with the second you get the greatest amount of volume possible for a regenerative receiver. That's all there is to it, except the simple control of the filament rheostat.

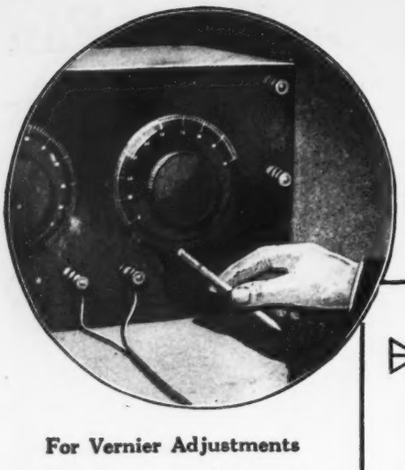
After experience you may find that the rotor can be left set and a slight variation in the condenser will tune out a 360-meter station and bring in a 400-meter station, eliminating all interference.

2. Keep the Tickler Out of Temptation.

From a large number of readers' letters it is apparent to me that the average newcomer in radio does not fully understand the action of the "tickler" or feedback coil which gives regeneration. In the first place, it must be understood that the vacuum tube itself has remarkable amplifying properties. The small currents received on the aerial are transferred to the grid—the control element of the tube—and this, governing the flow of electrons from the filament to the plate—immediately releases the large amount of energy stored up in the plate circuit and puts it to work in the phones.

Now, if we can get a large amount of energy on to the grid, we can release still more of the energy in the plate circuit. This is what the feedback coil does. After the initial impulse comes to the grid, it sets the plate circuit into operation. The energy from this circuit is passed through the tickler coil and by inductive means this energy is transferred to the grid circuit, which in turn again affects the plate. Such action is repeated instantaneously in each case until a certain maximum is attained, beyond which regeneration will not proceed because the tube goes into a state of oscillation that is excellent for transmission purposes but useless for reception.

Unless properly used, regeneration has a number of distinct drawbacks, one of which is squealing or howling. From the troubles that have been reported to me, it is apparent that a number of fans put the B battery positive connection next to the plate terminal of the socket. This method

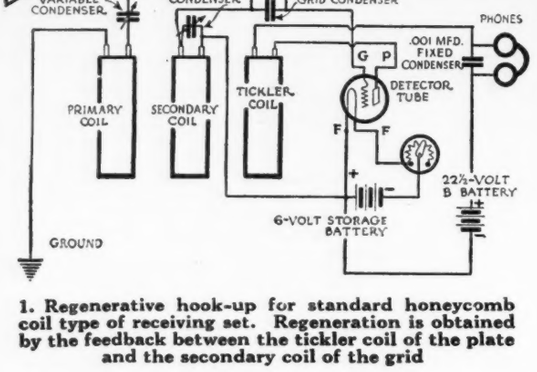


For Vernier Adjustments

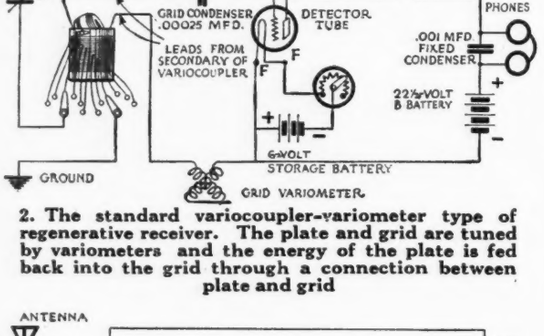
To make close adjustments, press the rubber eraser of a pencil against the notched edge of the tuning dial so that the rubber acts as a gearing. A slight turn of the pencil will then move the dial through an angle smaller than would be possible by turning the knob of the dial most carefully with your fingers

THE discovery of new methods of radio frequency amplification that can be applied by amateurs and even by novices, is probably the most important of recent radio developments. Jack Binns will tell you about it in next month's issue.

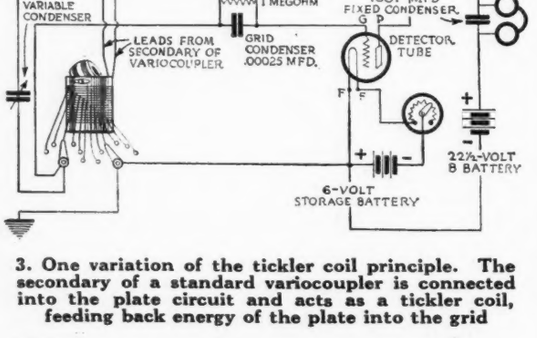
Four Methods of Regeneration



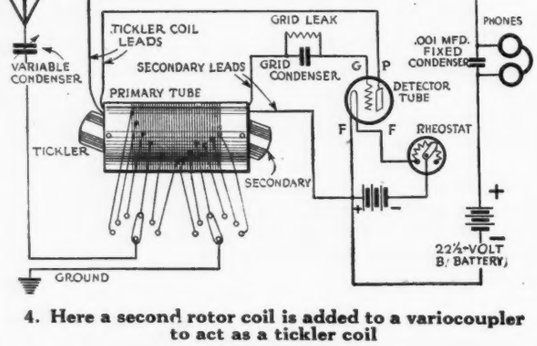
1. Regenerative hook-up for standard honeycomb coil type of receiving set. Regeneration is obtained by the feedback between the tickler coil of the plate and the secondary coil of the grid



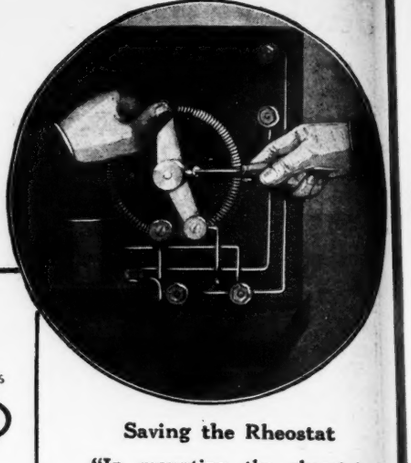
2. The standard variocoupler-variometer type of regenerative receiver. The plate and grid are tuned by variometers and the energy of the plate is fed back into the grid through a connection between plate and grid



3. One variation of the tickler coil principle. The secondary of a standard variocoupler is connected into the plate circuit and acts as a tickler coil, feeding back energy of the plate into the grid



4. Here a second rotor coil is added to a variocoupler to act as a tickler coil



Saving the Rheostat

"In mounting the rheostat, take care," says Jack Binns, "that the contact arm makes firm connection with the resistance wire." An effective way to do this is shown above. With your thumb press down the arm at the shaft, and at the same time tighten the set-screw, assuring permanent and firm contact

of connection is incorrect, for it is necessary that the tickler should be joined directly to the plate terminal of the vacuum tube. Then the telephones should be connected with the other side of the tickler coil. After the telephones, the B battery can come in, but not before.

After the connections are made, it is possible that no regenerative action will be experienced. This may be because the tickler coil is opposed to the primary winding of the variocoupler. In this case it will be necessary to reverse the connections on the tickler. Experiment will soon determine whether you have the connection right. The method by which you can determine this is described in the following commandment:

3. Worship the "Zero Beat."

Perhaps the most perplexing term in radio for the beginner is "zero beat." To understand it, another terrifying term—"heterodyne effect"—must be explained. First remember that the transmitting station consists of a radio set exactly the same in general principles as the single circuit receiver described in the first commandment, the main difference being in size and power. In the transmitting set, however, the feedback coil is so arranged and its filament so adjusted that the tube is in a constant state of oscillation, the frequency of this oscillation depending upon the inductance and capacity of the circuit about it.

Let us suppose that this frequency is 800,000 cycles a second—producing a wave length of approximately 375 meters. Any receiving apparatus that responds to this wave length will be unable to record anything in its telephones because the frequency is far too high for the telephones' diaphragms to respond to. Now, if we turn our receiving apparatus into a transmitter for a moment by making the filament glow brighter and increasing the feedback coupling, we can ourselves produce oscillations of a frequency as high as we desire within the limits of our tuning coil and condensers.

To understand the effect of this, consider for a moment the action of a tuning fork. If a tuning fork vibrating 256 times a second is placed near another fork vibrating 260 times a second, a listener a short distance away will hear a sound alternately swelling and dying four times a second—or of a frequency equal to the difference in frequencies of the two forks. In the same way, if two trains of radio waves of different frequencies interact or "interfere," the result will be a wave having a frequency equal to their difference. If, then, in our own receiver, put in a state of oscillation, we produce a wave having a frequency of 800,500 cycles a second, the interaction of this wave with the wave of 800,000 cycles a second will produce a "beat" wave having a frequency of 500 cycles a second which, since it is an audible frequency, will be heard as a musical note in the phones. That is the underlying principle of heterodyning.

Now, if you pay careful attention to the adjustments in producing this effect, you will observe a peculiar thing. The musical note will vary in its pitch as the dial of the condenser is turned. This variation will be from a very shrill high pitched tone to a very low pitched tone or vice versa, depending on the relative positions of the movable and stationary plates of the condenser. If you keep turning the knob, a position will be reached where the pitch becomes very low and the sound finally stops. If the knob is turned still farther, the low pitched note will begin again and

Your Radio Questions Answered

Address your questions to POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City, inclosing self-addressed stamped envelope

Jack Binns

Amplification for Crystal Detector

Q. Can radio frequency or audio frequency amplification be used in connection with an ordinary crystal detector?—A. R. D.

A. Both radio frequency and audio frequency amplification can be used. All that is necessary is to connect the output terminals of the radio frequency amplifying unit to the input terminals of the crystal detector circuit, and the output terminals of the crystal detector circuit to the input terminals of the audio frequency amplifying circuit.

Potentiometer Connections

Q. How can I connect a potentiometer into the circuit of a two stage regenerative set?—Howard O. Gardner.

A. To connect the potentiometer, disconnect the wire leading from the negative pole of the B battery to the A battery. Then connect the lead from one end of the resistance to the positive pole of the storage battery. Then connect the movable contact of the potentiometer with the negative pole of the B battery

Grid Leaks and Grid Condensers

Q. What are the best sizes of grid leaks and grid condensers to be used in regenerative circuits?—Donald A. Larkin.

A. It is impossible to determine beforehand just what values of grid condenser capacities and grid leak resistances will give you best results. You will have to try out various values. For the grid condenser either a .0005 or .00025 mfd. fixed condenser can be used. For the grid leak a resistance of from ½ to 5 megohms can be used. You can obtain tubular grid leaks of various sizes and substitute them into the circuit until you get best results with a certain size, or get one of the variable pencil mark grid leaks whose resistance can be varied by increasing or decreasing the number of pencil lines until best results are obtained.

Increasing Distance Range

Q. How can I increase the distance range of a two stage audio frequency amplifying set?—A. V. Menzies.

A. The distance range of a set can be increased by the addition of stages of radio frequency amplification. This form of amplification, however, is difficult to handle satisfactorily, and is not to be recommended unless the operator understands vacuum tubes and transformers.

gradually become higher and higher in pitch.

The point between the two low pitched musical notes where the receiver gives forth no sound at all, is known as the "zero beat." This is the best possible adjustment of the set for the reception of music, for the reason that maximum volume will be obtained and there will be no distortion.

What really happens, of course, is this: At the zero beat the incoming wave has exactly the same frequency as the wave that the receiving set is producing and, consequently, they do not clash. When the zero beat has been found on the set, the rheostat of the detector tube should be adjusted so that less current is flowing through the filament. As the rheostat is adjusted in this manner, it will be observed that the signals increase slightly in strength at first and then decrease. The rheostat should be left at the point where they are strongest.

When tuning a regenerative receiver to a broadcasting station, you should turn on the filament full and then, with your tuning apparatus, search for the carrier wave of the broadcasting station. You will note this from the characteristic whistle when the receiving set heterodynes on the carrier wave. The next thing is to adjust rheostat and tickler for the zero beat and then to manipulate the rheostat so that the clearest music is obtained.

The value of the vernier adjustments in a regenerative receiver, especially in connection with the feedback adjustment and the variable condenser adjustment, cannot be overestimated, since it is possible to tune a station in or out by the slightest movement, one way or the other, of the dials that control these adjustments. A method by which such an adjustment may be easily made is shown on page 70.

4. Protect the Receiver with Shields.

One of the peculiar things about a regenerative receiver, especially on short wave lengths such as are used in broadcasting, is body capacity. This is the condition that exists in all unshielded sets. No doubt you have observed that immediately after an adjustment is made and your hand is withdrawn, the set begins to squeal. If the adjustment is in a certain position, this squealing will stop as soon as you return your hand to the adjusting dial. On other occasions when the set is functioning perfectly, the moment you approach it, a terrific squeal will issue from the telephones.

You can eliminate this troublesome body capacity in only one sure way—by ground-shielding the set. Line the inside of the cabinet with very thin copper plate or tin plate. Solder the plating wherever there are any joints. It is necessary, of course, to make holes in these plates in order that the different connecting wires, the shafts of the variable instruments, such as the condenser, tuning coils, and other parts, can be passed through without touching the shield. The shield should then be soldered to the ground connection. If this is done carefully, the squealing effect produced by the body will be eliminated and accurate tuning will be possible.

In cases where the feedback coil is in an inductive relationship with the tuning elements of the receiver, a shield should not under any circumstances be placed between them. There is one exception to this rule, however, and that is in case of the variocoupler-two-variometer type of receiver. In this case shields can be placed between the three tuning elements, for regeneration in this type is obtained by tuning the three circuits into unison, as will be explained later.

5. Do Not Overwork the Rheostat.

The filament rheostat is the most important element in the regenerative receiver. It is constructed so that it can be mounted into a panel in two different ways and, in order to facilitate this, the manufacturers have made it so it can be taken apart easily. When mounting the rheostat, it is important to make sure that the contact arm is in firm contact with the resistance wire. If this is not done, the arm will make only a loose contact, with the result that when the rheostat is turned on, an arcing will take place at the point of contact, rapidly burning the wire on the rheostat and destroying the instrument.

There is one other thing to consider about the rheostat itself. In resisting the flow of current, it becomes heated. To keep the coils as cool as possible, be careful to mount the rheostat inside the cabinet in such a way that a free circulation of air can carry off the heat, which might otherwise burn out the resistance wires.

Since heat rises, the rheostat should not be mounted inside the top of a shallow cabinet nor should coils be placed in a small space. The best mounting for a rheostat is on a vertical panel clear of the other instruments in the receiving set.

Remember that the average rheostat in general use is designed to regulate the filament current of one tube only. When more than one tube is controlled by a single rheostat, the temperature rise in the resistance coils may become excessive.

6. Honor the Inductive Relationship.

Whatever type of regenerative receiver you may use, whether it is a honeycomb coil, a variocoupler with tickler coil, a variocoupler alone, or a variocoupler and variometer, remember that the inductive relationship of the feedback coil to the tuning apparatus is of utmost importance. To explain inductive relationship simply, we may state that if alternating or pulsating current is flowing through a coil, it will set up a similar current in any other coil that is in the correct relationship with it. This interaction between the two will be stronger or weaker, according to the distance the two coils are from each other. A little experiment will show that there is one point in the distance between the two coils where a maximum induction takes place between them.

For those fans who assemble their own regenerative receivers, this position can be very easily determined before the set is finally mounted on its panel by the method fully explained in my department last month.

The arrangements for varying this inductive relationship are amply provided for in such instruments as the variocoupler

(*Continued on page 103*)

Is Your Car Really Fixed for the Winter?

The Worst Weather Is Still to Come—Prepare for It Now and Save Expense Later

When the thermometer drops to zero and Old Man Winter lets loose his freezing breath, your driving enjoyment and safety will depend on whether you have taken the simple precautions indicated here. H. F. Blanchard, noted automobile authority, tells how to do it

By Harold F. Blanchard

MOST of us who complain whenever our automobiles are affiicted with "winter troubles," fail to consider that cars, like human beings, are sensitive to cold weather, and that if we would avoid expense and worry, they should be properly fed, clothed, and adequately protected from wintry blasts.

Balky engines and frozen radiators are curses of wintertime driving that might be easily prevented if car owners would take the time and trouble to make a few simple preparations before the coldest weather.

Two Essential Precautions

Two of the simplest and yet most important items of protection for the car are these:

Food: Adjust the carburetor to give a richer mixture in cold weather.

Clothing: Cloak the radiator with a cover or shutter:

Why does your engine require more gasoline in winter than in summer? Simply because gasoline does not vaporize and mix with cold air as readily as it does with warm air. Furthermore, cold air in a cylinder weighs more than warm air and therefore requires more power behind the piston to displace it.

The reason the radiator needs a covering or shutter is that the usual cooling system is designed to cool the engine in hot weather and becomes supereffective in winter.

A shutter is ideal for regulating the temperature of the engine. It may be opened or closed by a handle on the instrument board or by a thermostat located in the shutter. A radiator thermometer is essential, otherwise it would be difficult to determine just what the temperature of the engine is. A hood cover is a further economy because it prevents dissipation of heat into the atmosphere, with consequent waste of fuel.

Supplementing these si nple preparations is the use of soft grease for the cups. Lighter oils and greases are often advisable, but most engines will operate satisfactorily with a medium oil all year round.

Just why does an engine balk in cold weather?

One of the chief reasons has already been mentioned—slow vaporization of gasoline. A second important cause is that the battery is likely to be below normal. In winter the car is used chiefly around town. The engine is stopped and started frequently and is not run continuously enough to keep the battery charged. Furthermore, the fact that the engine is harder to start in winter strains the battery. Lights are used more during the shorter days, and cold weather itself numbs the battery. For all these reasons the battery should be given an outside charge as soon as it shows signs of weakening.

Starting the Cold Engine

Engine starting is another difficulty that is almost as troublesome to the unprepared auto owner as engine balking. In moderately cold weather the average driver usually relies on his choke to start a cold engine. But this method is effective only if the battery is in good condition, the spark plug points are properly set up, and the breaker points adjusted to the correct gap. Many batteries have worn out because the choke was not doing the work it was supposed to do. Choke parts may wear, stick, or slip, or the choke may never have been properly adjusted. The first thing to do in getting ready for winter, therefore, is to see that these parts are in good condition and carefully adjusted.

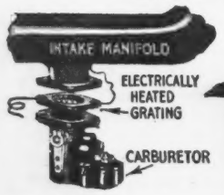
When cranking the engine, the choke should be pulled out all the way. But care should be taken to push it back as soon as the engine has warmed up a little. If the engine is operated with the choke out, worn bearings and worn cylinders must result because of excessive dilution of the engine lubricant by the large amount of raw gasoline the choke forces the engine to breathe. When the choke is not sufficient to start the engine, the carburetor may be flooded by raising the float valve off its seat and holding it off until fuel leaks out of the carburetor.

Ether Useful in Zero Weather

But when zero weather comes, these simple expedients often fail. If a car has been thoroughly chilled by standing in an unheated garage or by remaining in the open several hours, it will require priming of the cylinders with gasoline to start it. If this first aid has no effect, ether should be used for priming. A pint bottle sufficient to last most motorists all season costs about 60 cents. The ether may be introduced by

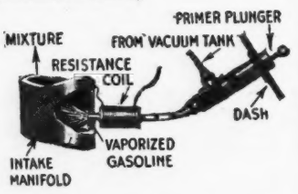
Three Best Remedies for a Balky Engine

Designed to make the auto engine start readily in the coldest weather, these three electrical devices heat and thus quickly vaporize gasoline in the intake. Any one of them may be installed easily



This electric mixture heater consists of an electrically heated grating mounted in a gasket placed between carburetor and intake manifold

Here the mixture is warmed by a plug electrically heated by a resistance coil and screwed into the intake manifold



In the typical primer is inserted a resistance coil that vaporizes fuel drawn from the vacuum tank by a plunger on the instrument board and sprayed into the manifold

How to Start Your Car in Cold Weather

PULL OUT CHOKE

TICKLE CARBURETOR BY LIFTING OR DEPRESSING FLOAT NEEDLE

PRIME CYLINDERS WITH GASOLINE THROUGH PET-COCKS OR BY REMOVING SPARK PLUGS

PRIME CYLINDERS WITH ETHER OR FILL CARBURETOR FLOAT CHAMBER

FILL RADIATOR WITH HOT WATER.

PUT GASOLINE ON SPARK PLUGS AND APPLY MATCH

priming the cylinders through the petcocks or by etherizing the carburetor with a rag moistened with the substance. Then, if the car doesn't start, the gasoline should be turned off, the carburetor drained, and the float chamber filled with ether. After that, turn on the gasoline and crank the engine. With that shot of ether, even the balkiest engine should start immediately and continue running on the ether until it is warm enough to run on the gasoline.

The typical primer consists of a plunger on the instrument board that draws fuel from the vacuum tanks and sprays it into the intake manifold. The engine may also be primed by squirting gasoline into the petcocks. If these are clogged with carbon, they should be bored out with a small screwdriver, gimlet, or drill. If the engine has no petcocks, spark plugs equipped with priming cups may be purchased.

Emergency Measures

If you have not taken the precaution of carrying a bottle of ether for emergency and your car should be stalled in the country where ether is not obtainable, the best plan is to drain the cooling system and fill it with hot water. Other first aids are these: Remove the spark plugs, pour gasoline on them, and touch a match to them, then screw them back quickly before they lose their heat. Pour hot water over the carburetor, or wrap the carburetor in warm cloths or warm sand—anything to warm it up.

Refusal of the engine to start may be due to the freezing of water in the carburetor or in the gasoline piping. Any water that happens to be in the gasoline, or that condenses from the sides of the gasoline tank, will collect in a low spot and freeze. A gasoline filter is the only sure preventative and every car should have one. A less certain cure is to drain a little gasoline out of the carburetor bowl frequently, since any water that collects is likely to come off with it.

By far the best preventative for a balky engine is an electric mixture heater, consisting either of an electrically heated plug that screws into the intake manifold or a heat wire mounted in a special gasket and placed between the carburetor and the intake manifold. The heat generated quickly vaporizes the gasoline in the intake and the engine starts readily in the coldest weather.

If you use an electric mixture heater, it is not always necessary to heat your garage, provided the radiator of your car is filled with an anti-freezing mixture. However, it is well to keep the garage heated, if possible. You can do this by connecting the garage with the house heating system. Or you can purchase one of the automatically regulated gas or kerosene heaters especially designed to heat garages and keep automobile engines warm.

When the delivery duct of the heater is set up against the car radiator, the warm air heats the water in the radiator and so maintains the heat of the engine. Another type of gas heater draws water from the draincock of the car radiator, heats it, and then discharges it into the filler opening at the top of the radiator. Still another device is an electric heating pad, which when placed under the hood is capable of generating sufficient heat to keep the water warm and permit easy starting.

Neglect that Brings Ruin

Even if you have one of these water heaters, it is dangerous to assume that the anti-freezing liquid may be dispensed with. Countless radiators and engines are ruined every year because this precaution is not taken.

How can you tell when your automobile is frozen? There are several ways. For example, if your car is equipped with a water pump, the chances are that you can't crank the engine. Or if you do crank it, the pump will break. If you have no water pump, the first indication of freezing may be a steaming radiator. Blocked by ice at some point in the system, water is unable to circulate and gradually turns into steam, blowing out of the radiator vent pipe.

The task of draining the radiator and filling it with anti-freezing compound is so easy and so inexpensive that there is really no excuse for neglecting it and suffering the consequences. Anti-freezing compounds that give the best results are denatured alcohol, wood alcohol, glycerin, calcium chlorid or mixtures of these. Calcium chlorid is probably the best, because it does not evaporate like alcohol. Be sure that it is chemically pure or it is likely to corrode the engine.

For a zero freezing point, three punds of calcium chlorid to a gallon of water should be used, while four pounds to a gallon will give a freezing point of 17 below zero. Either a mixture of 40 per cent denatured alcohol and 60 per cent water, or 24 per cent wood alcohol and 76 per cent of water gives a zero freezing point. A 48 per cent mixture of glycerin and water freezes at zero and a 58 per cent mixture at 10 below. Equal parts of glycerin and alcohol mixed with 71 per cent of water will give a zero freezing point. Many motorists use anti-freezing compounds on the market.

Draining the Car

If the car is exposed to cold weather without the protection of an anti-freezing liquid, the cooling system should be drained. Make sure that no water remains in any part of the system. Water in the engine oil sometimes blocks the circulation and, if it freezes in the pump, may break it when the engine is restarted.

I have outlined the most important preventatives of automobile winter troubles, the causes of which, it must be emphasized again, usually originate in our own neglectfulness, rather than in our cars. A few secondary precautions and conveniences are also important to the enjoyment and safety of winter driving. Chains should always be used when there is snow on the ground, especially when there are hills to climb. If the snow is well packed, it is essential that the chains be attached so that the fastening links will tend to close when the chain slips and to open when the wheel slips.

To keep your body warm while driving, a footwarmer operated by the exhaust may be purchased. There are a number of varieties of these on the market. Another type uses hot water from the radiator, and still another is a charcoal heater that burns for hours without odor or flame.

A hot water bottle placed under the robe on your lap, electrically heated gloves, or electrically heated pads laced to the steering wheel will help remarkably when you suffer from cold fingers. Such comforts make winter driving a pleasure.

Know Your Car

IT IS just as important to keep your storage battery charged as it is to keep your tires inflated. An uncharged battery will soon be ruined. Overcharging also is injurious.

You can determine the condition of your battery by the tone of your auto horn. A high pitch indicates an overcharge; a low pitch, an undercharge.

Lack of sufficient water ruins more batteries than do overcharges and undercharges.

You'll remember these simple, worry-saving facts more easily if you understand the construction of your battery. It consists of a "battery" of cells connected in series—one cell for every two volts. Each cell consists of a hard rubber jar filled with thin, vertical plates, alternately positive and negative, separated by wood or rubber. The positive plate consists of a lead framework filled with lead peroxid. The negative plate contains pure lead in a porous state.

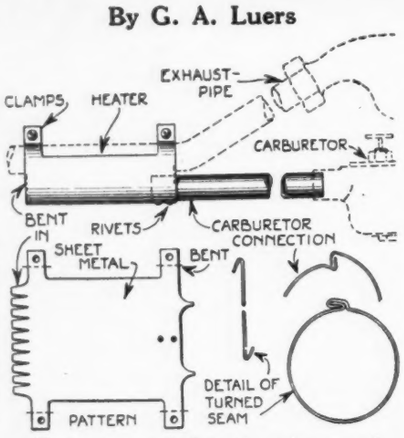
The plates are immersed in a solution of sulphuric acid and water, called "electrolyte," much heavier than water. As the battery discharges, the lead and lead peroxid on the plates are changed to lead oxid on both plates and there is also a formation of lead sulphate that causes the lowering of the specific gravity of the electrolyte by the loss of sulphur and oxygen.

The condition of the electrolyte in each cell should be tested frequently for specific gravity with a hydrometer syringe. The specific gravity should be raised only by charging.

Carburetor Heater Helps to Save Gas

By G. A. Luers

THE average carburetor heater is not sufficiently large to obtain maximum economy in the use of gasoline, especially on cars several years old. The carburetor and intake manifold should be too hot to place the hand on comfortably, for then the gasoline and gasoline vapor in contact with these surfaces separate into the vapor most readily burned when it reaches the cylinders. Any owner of a car can add to the carburetor a heater that will supply an abundance of warmth and result in economical operation, with the added advantage that the car can be throttled down to a lower speed.



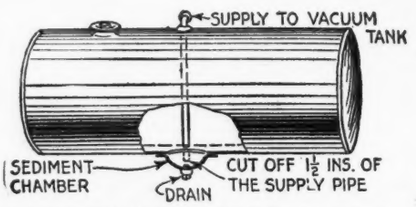
Heater is attached to the exhaust and connected by pipe with the carburetor

The body of the heater is sheet iron formed to a pattern as indicated and secured with clamps to the exhaust pipe. The connection with carburetor is by means of a pipe rounded to shape over a mandrel, and bent wherever necessary to bring it in line with the carburetor. This connecting pipe is fitted with an adjustable opening that can be arranged in any convenient way for use in hot weather.

As a preliminary to forming these heaters, a pattern of the part should be made of heavy paper and fitted in place. When the pattern is correctly fitted, the metal is then cut from the paper pattern. The immediate effect of the added heat will be noted in the carburetor adjustment. As much a reduction as a half turn of the needle-valve is obtainable after operating the motor several minutes with the heater properly connected.

To Keep the Automobile Gas Line from Freezing

EVERY winter gas lines freeze because of water in the tank. This is mainly due to the fact that water gets into the garage gasoline supply from the street level because the driver of the supply wagon does not sponge out the filling chamber before unscrewing the cap, thus allowing rain and melted snow to run into the storage reservoir, from which it is pumped into the tanks of automobiles along with the gasoline.



Lower end of supply pipe in tank is cut off

I found that by cutting off about 1½ in. from the lower end of the supply pipe, a reservoir of more than a gallon is formed at the bottom of the tank.

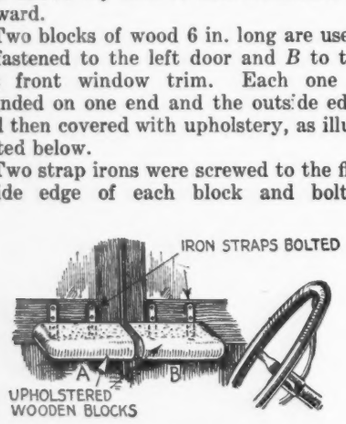
There is another advantage in this arrangement: If you happen to run out of gasoline, you can unscrew the tank plug and fill some of the reserve into the vacuum tank.—ERNEST T. OLDFELT.

Arm Rest Relieves Fatigue of Driving Ford Sedan

TO DRIVE a Ford sedan many miles is tiresome because there is no logical place to rest the left arm, so I built a rest that allows my arm to slide backward or forward.

Two blocks of wood 6 in. long are used, *A* fastened to the left door and *B* to the left front window trim. Each one is rounded on one end and the outside edge and then covered with upholstery, as illustrated below.

Two strap irons were screwed to the flat inside edge of each block and bolted through the window trim and door. By unloosening the nuts, the bolts can be removed at any time and the rest taken off. There are no fastenings to vibrate, as on portable arm rests.

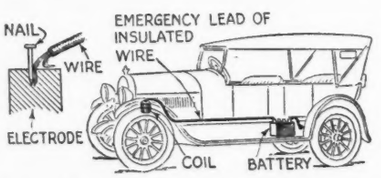


The arm rest in place

The ends of the blocks almost butt together when the door is closed and make a continuous rest.—L. B. ROBBINS.

Trick Wiring Quickly Starts Stalled Car

A MOTORIST in distress recently asked for help because his ignition had failed. In view of a threatening snowstorm and rapidly approaching darkness, it was desirable to remedy the trouble as quickly as possible. A hasty examination showed that the fuse was intact; but the maze of wiring of the switchboard and the connecting instruments was far too complicated to detach and make any repairs, even with the manufacturer's chart at hand to explain the intricacies of the wiring. Nevertheless, we had the motor running in less than five minutes. The means used was simply a 12-ft. length of insulated wire connected as shown.



A length of insulated wire, kept for emergency, is run directly from battery to coil

When the ignition fails and the trouble seems to be somewhere between the coil and the battery, the quickest way to get the engine going is to run a special wire direct from the battery to the coil.

Inasmuch as there are usually from two to four terminals on the coil, it is not always easy to say which is the right one. Sometimes the manufacturer's instruction book will indicate it, or the right terminal may be determined by trial; usually it will be the terminal which indicates a live circuit when tested by the simple process of rubbing the special wire on it when the breaker points are closed. In connecting the end of the special wire to a terminal, be sure that the regular wire has first been disconnected.

The other end of the special wire should be connected with the side of the battery that is not grounded. Care must be exercised to obtain a good connection at this point. Scrape the electrode clean, and if any difficulty is then experienced in obtaining a good spark, make a nail hole in the electrode and wedge a few strands of wire into it, as illustrated.

When this connection is made, the ignition switch will be inoperative, but the engine may be stalled by bringing the car to a stop and letting the clutch in gently while the brake is on. Care should be taken to crank the engine immediately after making the connection and to disconnect the wire as soon as the motor stops in order to prevent the coils becoming overheated.—M. R. V

How to Avoid Noisy Shifting of Gears in Cold Weather

IN COLD weather, when the oil in the gearcase is more sluggish than in summer, we are apt to do more noisy gear shifting. The reason for this is that it is harder to move the gears in and out of mesh when the lubricant is heavy, and this means we often allow one shaft to slow down too much in relation to the other, causing clashing.

Or, due to the sluggish lubricant, the shifted gear-teeth are allowed to grate against those of the other gear, with the same clashing noise. The experienced driver, therefore, uses a lighter lubricant in cold weather, and, in fact, most of the oil companies recommend a lighter grade of gear compound for winter use. In any case, use more force and remember the causes of the clashing, and you will be less apt to shift noisily.

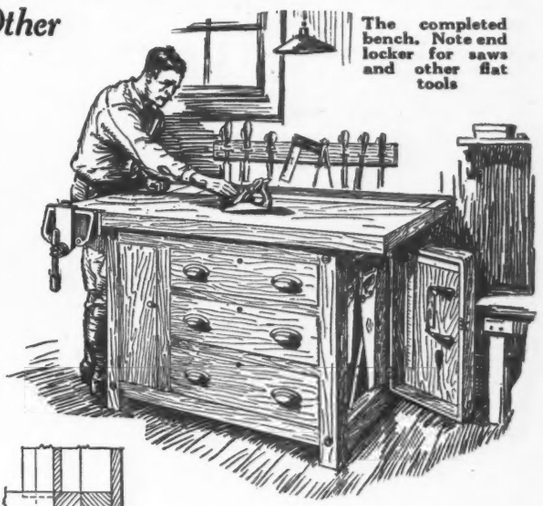
Throw the gears into position with a quick, positive stroke and you will seldom have trouble.—F. J. J.

The Home Workshop

New and Useful Things to Make with Tools

Building the Ideal Home Workshop Bench at Home

Plans for a Cabinet Type Workbench and for Other Kinds that Can Be Made at Little Cost



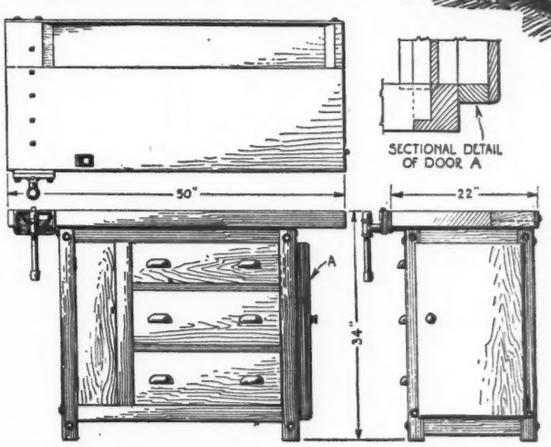
The completed bench. Note end locker for saws and other flat tools

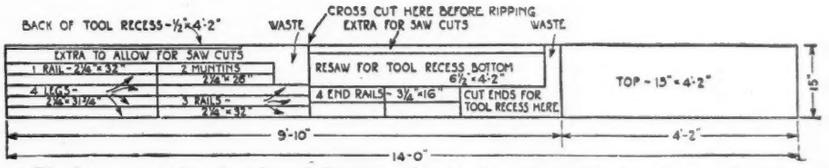
THE accompanying article contains full instructions for building the ideal home workshop bench. Readers who desire, in addition, complete working drawings and bill of materials may obtain our workbench blueprint, No. 15 in the Home Workshop series, by sending 25 cents to the Blueprint Service Department, Popular Science Monthly, 225 West 39th Street, New York.

NOTHING is more essential to the comfort and pleasure of working with tools than a strong, substantial bench with a good vise. If it is like the cabinet workbench illustrated at the right and has drawers and tool cabinets, so much the better, for it is a constant incentive to keep tools in order and to give them the care and attention they deserve. With such a bench and a set of tools of standard quality, the home worker can hardly fail to do a hundred and one useful and interesting jobs that otherwise would never be undertaken.

This cabinet bench, which has been designed by the Home Workshop Department as an ideal workbench for the home shop, has three drawers for tools, an end cabinet for saws, steel square, and other flat tools, and another locker opening from the front near the vise to take the drawingboard, T-square, roll of drawing paper, blueprints, and other drafting equipment.

Mechanics differ in their preference as to the height of a bench, some authorities recommending benches as high as 39 in. and others as low as 32 in. The standard practice is 33½ or 34 in. This bench is 34 in. high and has a top 22 in. by 4 ft. 2 in. The working part of the top is 15 in. by 4 ft. 2 in., the rear part being a tool recess. Provision is made for the usual 7-in. woodworking vise. If a larger one is desired, the top should be shifted to the left far enough to accommodate the vise. A machinist's vise can be clamped to the top toward the right-hand end whenever needed.



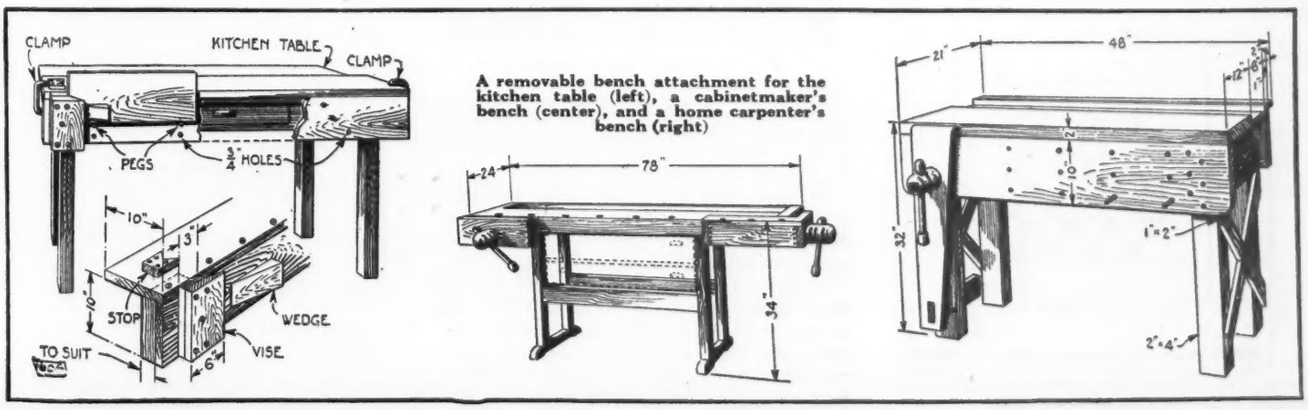

BACK OF TOOL RECESS - ½"x4'-2"
WASTE
CROSS CUT HERE BEFORE RIPPING
EXTRA FOR SAW CUTS
WASTE
EXTRA TO ALLOW FOR SAW CUTS
1 RAIL - 2¼" x 32"
2 MUNTINS 2¼" x 28"
4 LEGS - 2¼" x 3⅛"
3 RAILS - 2¼" x 32"
RESAW FOR TOOL RECESS BOTTOM 6½" x 4'-2"
4 END RAILS - 3¼" x 16"
CUT ENDS FOR TOOL RECESS HERE
TOP - 15" x 4'-2"
15"
9'-10"
4'-2"
14'-0"

The home workshop bench and diagram, showing how to cut the top, legs, and rails from one plank 15 in. by 14 ft. or two planks 7 1/2 in. by 14 ft.

The top, tool recess ends, legs, and rails are all of 2¼, 2⅜, or 2½-in. maple. All the parts can be sawed from a single plank 15 in. wide and 14 ft. long, or two planks 7½ in. wide and 14 ft. long, provided they are laid out in the most economical way, as shown in the accompanying diagram. In getting the stock for the bench, it is advisable to go to a lumber yard and select a sound maple plank or planks as near as possible to these dimensions (the thickness being more or less immaterial, provided it is more than 2 in.), and have it sawed in the lumber yard mill.

Either lay out the lines directly on the plank or else attach accompanying diagram or a copy of it to the order. The charge for sawing will be reasonable and the total cost will be considerably less than if a bill of materials for

(*Continued on page 93*)



A removable bench attachment for the kitchen table (left), a cabinetmaker's bench (center), and a home carpenter's bench (right)

How to Build Efficient Home Radiator Humidifiers

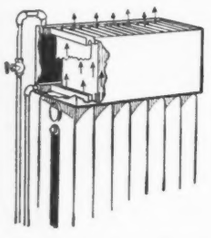
Two Tested Devices that Are Easy to Construct and that Have Large Surfaces of Evaporation

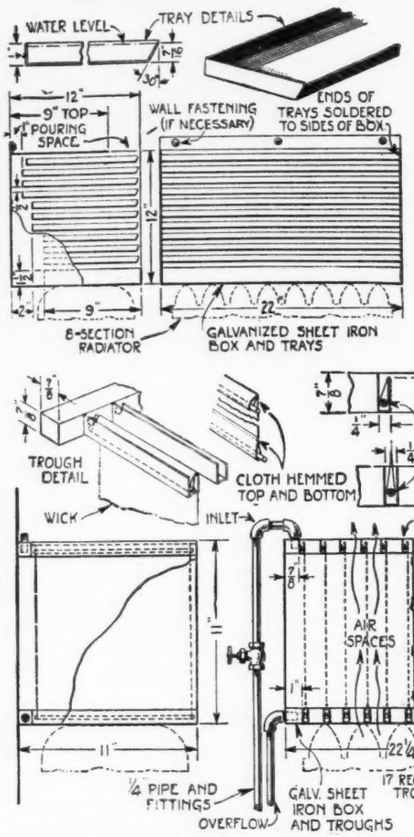
By James S. Godfrey

OUR universal neglect of the precaution of moistening the air in our homes, in winter, to protect the family against colds and other winter infections, was assailed in a remarkable article by Harry Mount, in the December issue of POPULAR SCIENCE MONTHLY. This unhealthful dryness of homes heated by steam or hot water radiators can be remedied by either of two tested humidifying devices, designed by E. P. Lyon, Dean of the Medical School of the University of Minnesota. Readers who wish to construct a set of humidifiers to mount on their radiators will find valuable the drawings and construction details in the following article.

The best method for securing a proper circulation of moist air in a home heated with a pipe or pipeless furnace was described fully in the November Home Workshop, which also contained instructions for making and reading a hygrometer—the simple instrument used to determine whether the relative humidity in your home is adequate.—THE EDITOR.

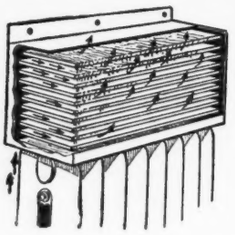
TWO types of radiator humidifiers, that will evaporate approximately 1½ to 3 gallons of water a day for each lineal foot of radiator, can be built at little cost for materials, by any one who can solder a tight seam. One humidifier consists of a series of trays, and the other of a series of small troughs in a galvanized iron casing. These are placed over the radiator in such a way that warm air ascending from the coils passes over a large area of moisture.





Upper views show working details and completely assembled humidifier of the tray type; the lower drawings make clear the construction of a typical trough humidifier with cloth curtains

If it is not desired to undertake the sheet metal work involved, the humidifiers may be made to order at a tin shop, for a reasonable sum, from the accompanying details. Simply select the type of humidifier preferred, clip out the illustration, paste it on a sheet of paper and note beneath it the length and width of the tops of the radiators for which humidifiers are to be made. Indicate also whether the tops of the radiators are flat or rounded; if they are rounded, provision must be made for fastening the humidifiers against the wall.



The first type of humidifier is an arrangement of shallow galvanized iron trays placed one above the other with ½-in. intervals between. The trays are as long or a trifle longer than the radiator and their ends are soldered to two galvanized iron end pieces. The width of the trays varies, becoming wider toward the top, except in the case of the uppermost tray, which is a trifle narrower than the one below in order to avoid the danger of splashing water on the floor when filling it.

Each tray is 1/16 or ⅛ in. deeper at the back than the front, and the front edge is placed at an angle. This arrangement is necessary in order that the overflow will not run down the back and through to the floor but over the front edge and into the tray beneath. The bottom

(*Continued on page 115*)

Wallboard Makes Fine Crokinole-Carom-Checker Board

By A. Neely Hall

ONE of the lads who posed for the accompanying photograph of a homemade crokinole and checkers board became so interested in the board that I furnished him with a rough sketch, and he hurried home to make one just like it. Two days later, when I met him in the paint store, he told me that the board was then ready for the finishing touches. So,

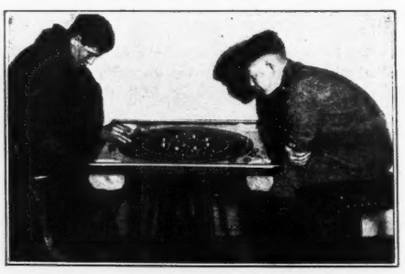


Fig. 1. A hotly contested game

you see, it does not take long to make one, and if you do your work well, you will have a game board that will last long enough to be handed down to another generation.

Figure 1 shows the side of the board on which crokinole is played. Figure 2 shows the opposite side, on which checkers, caroms, and other games are played.

The most satisfactory material for the board is wallboard. Two pieces are needed, a square piece, *A*, Fig. 3, and a circular piece, *B*. The smallest size sheet in which wallboard comes is 32 in. by 7 ft. There will be several feet of waste in this size sheet, but there are so many things that can be made of wallboard that you should be able to use practically every scrap.

Wallboard is easy to cut. You can saw it just as you would saw a board, or you can cut it with a knife. In using a knife, you

(*Continued on page 96*)

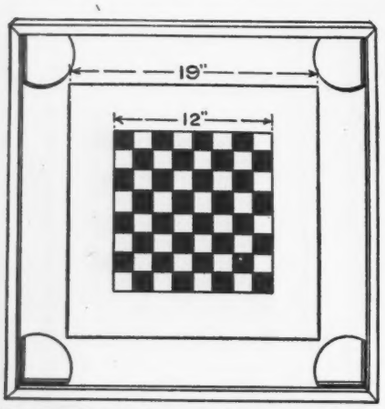


Fig. 2. How to lay out the carom-checker side of the board

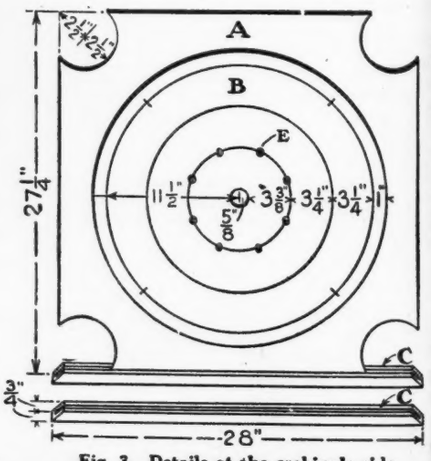
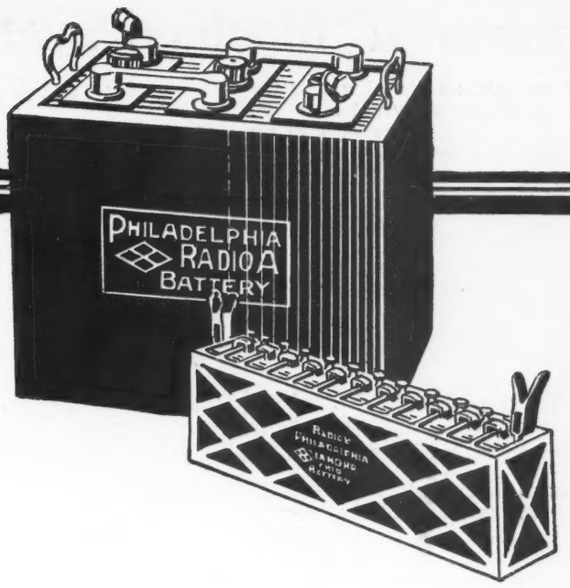


Fig. 3. Details of the crokinole side and strips for the frame



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Drynamic Radio A and B Batteries

Stop

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The new Philco Drynamic Radio Batteries absolutely eliminate objectionable battery noises. Also need for frequent and troublesome tuning in. Think of the increased pleasure and satisfaction you can now get from your radio set!

Philco Drynamic Batteries are a revolutionary development in battery engineering. Their phenomenal new "Philco Process Plates," plus other time-tested features, insure constant, uniform voltage—an absolute essential for satisfactory radio reception.

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Philco Batteries also give you *the longest service per charge and the longest battery life.* They are attractively finished—sealed tight to prevent acid leakage—convenient to handle.

Ask your radio dealer to show you these remarkable new Philco Batteries—or go to the nearest Philadelphia Diamond-Grid Battery Service Station.

RADIO DEALERS—Philco Drynamic Batteries let you into the storage battery business on a package goods basis. No acid sloppage. No charging equipment. No batteries going bad in stock. Wire or write for details.

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Sirs: I want to know more about the new Philco Drynamic Radio Batteries.

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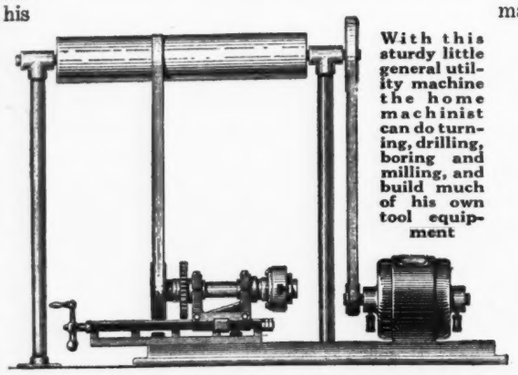
"Universal" Machine Gives Wide Range of Service

By Joe V. Romig

THE greatest need of the amateur mechanic, especially the man who wishes to do machine work in his home or garage, is proper machine tool equipment. No one can build models out of rough cast material or do any considerable amount of metal work without the aid of machinery to turn, bore, drill and ream. Although such work can be done in local shops, the costs mount so rapidly that usually it does not pay. Therefore, in planning his shop, the amateur mechanic always figures on installing a small lathe, a sensitive drill press, a tool grinder, and other machine tool equipment. Meager as this installation may be, it costs a relatively large amount and frequently, for want of so much cash, the home worker shelves the idea and, in consequence, the shop does not materialize.

On the other hand, the home machinist would gladly undertake to build his own equipment if he knew how to start. And that is not so difficult as it appears, especially if the first tool built is a simple machine of wide utility, like the one illustrated. It then can be used for machining the parts of more complete and complex machines.



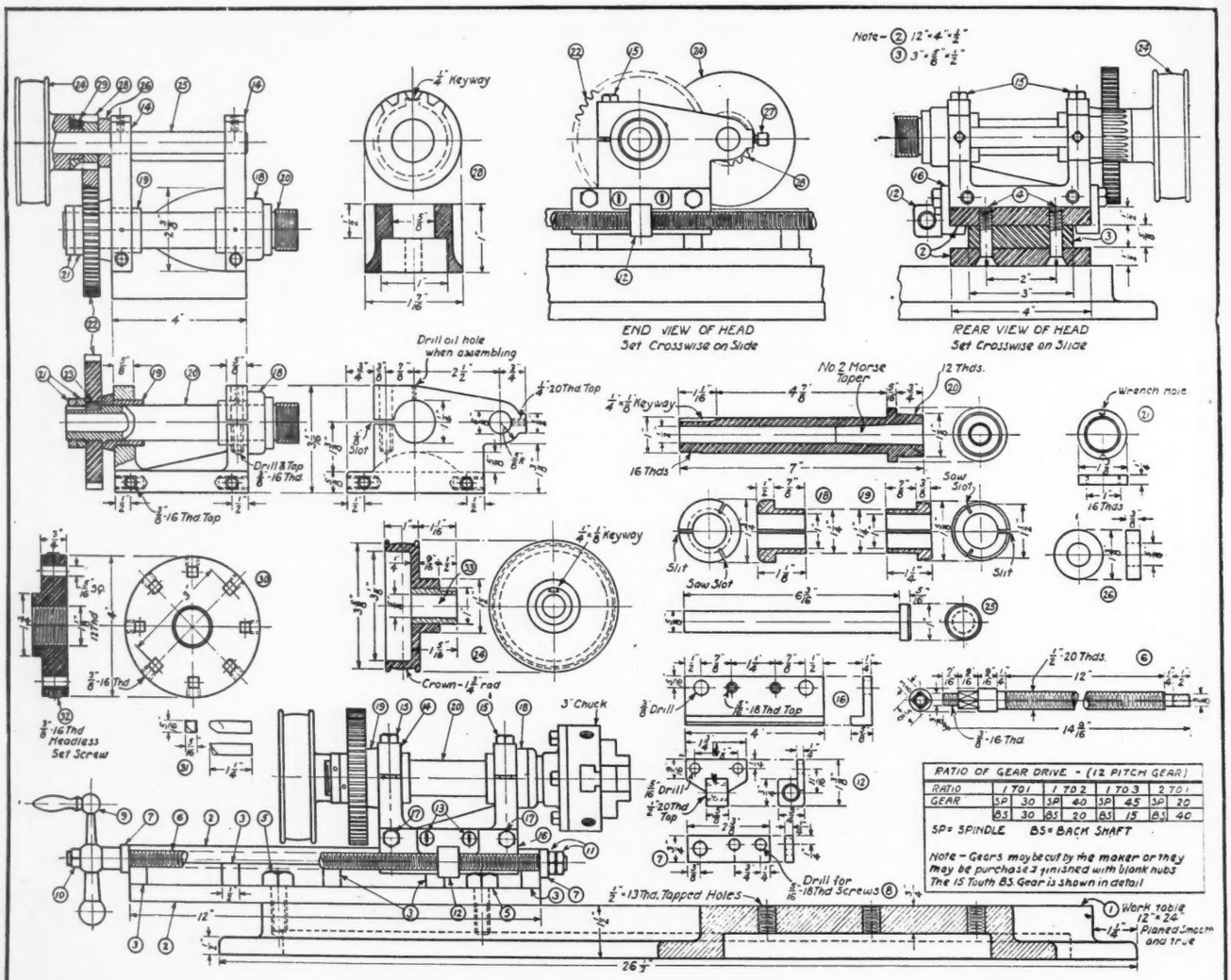
With this sturdy little general utility machine the home machinist can do turning, drilling, boring and milling, and build much of his own tool equipment

Because of its general utility, the writer suggests that this machine be called the "Universal." It combines some of the features of the drill press, horizontal boring machine, miller and lathe, all in one easily built machine.

The rugged head runs on one slide that can be set at any angle on top of the work plate. The head can also be set in two positions on the slide. A ¼-hp. motor is sufficiently strong for driving the machine. The countershaft is nothing more than a drum mounted overhead on bearings made from pipe fittings. The bed or work plate is cast in good gray iron from a simple pattern. Machined true on its top face, it is laid out and drilled for the ½-in. tapped holes, which are spaced 3 in. apart, as shown. These holes should be countersunk prior to tapping, to prevent the possibility of raising a burr in threading. The plate also serves as a surface plate for laying out work.

The slide of the machine is built of flat cold rolled steel, the top and lower plates

(*Continued on page 111*)


END VIEW OF HEAD
Set Crosswise on Slide
REAR VIEW OF HEAD
Set Crosswise on Slide
Keyway
Drill oil hole when assembling
Drill & Tap 5/8-16 Thd
5/8-16 Thd Tap
Slot
No 2 Morse Taper
12 Thds.
16 Thds
Saw Slot
Slit
Wrench Hole
3" Chuck
Crown-1/4 rad
5/8-16 Thd Headless Set Screw
Drill
18 Thd Top
20 Thd Top
Drill for 16-18 Thd Screws
1/2-13 Thd. Tapped Holes
Work table 12"x24" Planed smooth and true
RATIO OF GEAR DRIVE - (12 PITCH GEAR)
SP= SPINDLE BS= BACK SHAFT
Note - Gears may be cut by the maker or they may be purchased finished with blank hubs The 15 Tooth BS Gear is shown in detail

Details of the "Universal": The identifying number, name, material and number required of each part

1	Worktable	C.I.	1
2	Shear plates	C.R. St.	2
3	Cross webs	C.R. St.	5
4	F.H. screws—5/16x1⅜	St.	10
5	Cap screws—½x1¼	St.	4
6	Feed screw	St.	1
7	Feed screw plates	C.R. St.	2
8	Plate screws 5/16x¾	St.	4
9	Feed screw handle	St.	1
10	Handle nut—⅜ in.—16 thd	St.	1
11	Feed screw locknuts	St.	2
12	Feed screw nut	Brass	1
13	Feed screw nut screws —5/16 in.	St.	2
14	Head	C.I.	1
15	Head bolts—⅜x1¾	St.	2
16	Head slide plates	C.R. St.	2
17	Slide plate cap screws ⅜ x 1	St.	4
18	Bearing—front	Bronze	1
19	Bearing—rear	Bronze	1
20	Spindle	C.R. St.	1
21	Spindle lock collars	C.R. St.	2
22	Spindle gears (see gear table)	St.	4
23	Gear key—¼x¼x7/16	St.	1
24	Drive pulley	St.	1
25	Back shaft	C.R. St.	1
26	B.S. collar	C.R. St.	1
27	B.S. setscrews—¼ in.	St.	2
28	B.S. gears	St.	4
29	B.S. key—¼x¼x½	St.	1
30	Milling head	M.S.	1
31	Milling blades	Tool St.	8
32	Milling setscrews	St.	8

STANDARD LOADS of DU PONT SHOTGUN POWDERS

Kind of Game	DUPONT (Bulk) SMOKELESS 12 GAUGE DRAMS	12 GAUGE OZ SHOT	16 GAUGE DRAMS	16 GAUGE OZ SHOT	20 GAUGE DRAMS	20 GAUGE OZ SHOT	SHOT SIZES ALL GAUGES
Turkey Geese	3½	1-⅛	2¾	1	2½	⅞	* 2 & 4
Brant Large Ducks	3¼	1-⅛	2¾	1	2½	⅞	4 in flight 0 over decoys
Medium Ducks Grouse Prairie Chicken	3¼	1-⅛	2½	1	2¼	¾	6
Squirrels Rabbits	3	1	2½	1	2¼	¾	6
Small Ducks Pheasants Pigeons Doves	3¼	1-⅛	2½	1	2¼	¾	7½
Quail Snipe Woodcock Shore Birds	3	1 or 1-⅛	2½	1	2¼	¾	8
Reed Birds	3	1	2½	1	2¼	¾	10
Trapshooting	3	1 ¼	2½	1	2¼	¾	7½

BALLISTITE (Dense) SMOKELESS

If BALLISTITE (*dense*) Powder is desired order by grains. A comparison follows of *Bulk* and *Dense* Loads:

DRAMS		GRAINS	DRAMS		GRAINS
3½	equivalent to	28	2½	equivalent to	20
3¼	" "	26	2¼	" "	18
3	" "	24	2	" "	16
2¾	" "	22	1¾	" "	14

★ In 12-Gauge loads only, use No. 2 Shot.

When you **do** *get the time for a few days' shooting, you want to make every shot count. If you select* **standard** *loads from the table above, you don't need to worry about your ammunition. A century of experience will be behind your trigger finger.*

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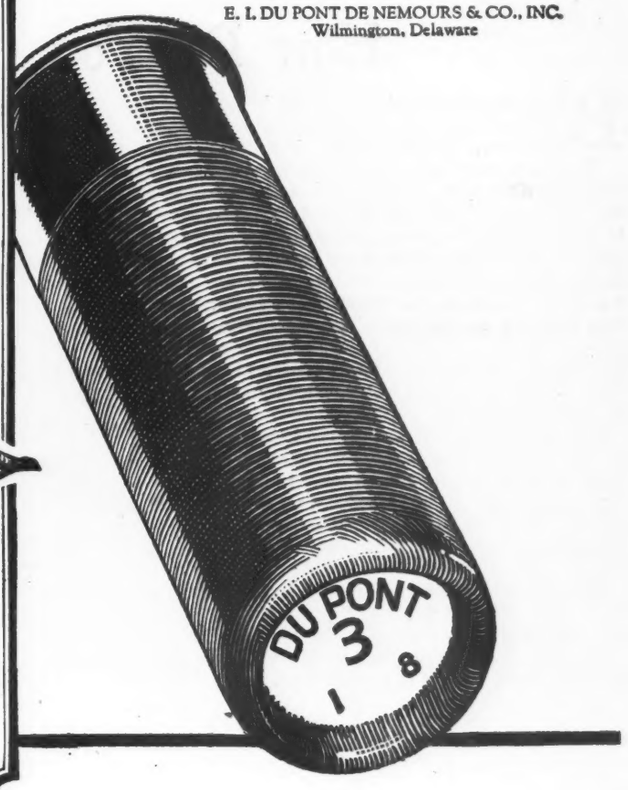


What every man wants in a shotgun powder is given him in "Du Pont" and "Ballistite".... that means confidence —and that means a full game bag. Is that not reason enough to look for the name on the carton and top shot wad?

SHOOT DU PONT POWDERS

DU PONT

Better Shop Methods

How Expert Mechanics Save Time and Labor

How Do You Grind Your Tools?

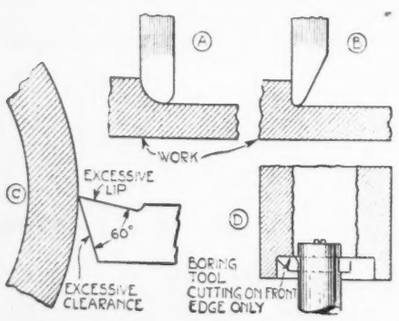
By Joe V. Romig

BILL ran the shop's big 10-ft. boring mill, a husky, motor-driven brute of a machine. Yes, he ran her. But how?

Tom, a young high school grad, was running the 8-ft. mill. Skelly, the lad across the aisle, operated the 60-in. lathe, the biggest lathe in the shop, and he ran it well. Shorty, although a floor hand, was called to the 48-in. planer when work on the floor was slack. Harry, the crack lathe hand, was running an old tool lathe of 18-in swing; Luther, his buddy, was knocking around the shop as an extra man, working rush jobs on machines left vacant by sick or absent operators.

The first day I started to work in this particular shop, I met each of these men, who with others operated the machine tools in a foundry and machine manufacturing plant. I soon came to know them as representing various extremes in their practice of tool grinding and tool usage.

Every machinist has his own ideas of what constitutes a perfectly ground tool, and no two men either grind or use their tools alike, unless educated to a single correct standard. Even if the finished work



Roughing tools ground by Bill, Tom and Skelly are shown at *A*, *B*, and *C*. Luther's boring tool is illustrated at *D*

of different machinists will interchange and pass the inspection standards, the cost of the work varies with each operator because of the way he handles his tools. Indeed, the difference of opinion in regard to the proper grinding of tools and their most efficient usage is exceedingly costly in the long run because of broken and burned tools, excessive power consumption, and wasted time.

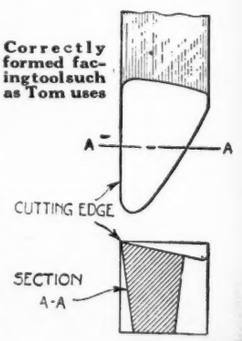
Tests have been made by all the well known tool steel companies to establish the best angles of lip, rake and clearance, and these findings are available to almost any mechanic in the public libraries of his city or town. Any mechanic who has not passed the "learning age" will quickly understand the theory and reasons for the best systems of tool grinding if he will take advantage of these researches, and that knowledge will make him a more accurate and rapid workman and also will save him effort and worry.

Bill had been running his particular boring mill for the past five years. In fact, I was told that he had set her up on her foundation when the company bought her, and he was still using his original set of 1½ by 2-in. tools, many of which were so short and stumpy that only one setscrew in the tool head could be used to clamp them. The tools simply reflected Bill's shiftlessness and neglectfulness.

All of Bill's round nose roughing tools were ground with a great, wide, sweeping radius so that when cutting to a depth of only ½ in. in a steel casting, they would throw a chip an inch in width. One can well imagine the extra amount of power required by a tool having so much bearing on the cut. It was funny, though, that when the manager brought visitors through on a tour of inspection, he always stopped at Bill's boring mill and called attention to the big black and blue chips that fell from Bill's blunt "metal pushing tools," as we had named them.

Many a time have I heard the old heavy duty motor with its geared drive groan under the strain of shoving Bill's blunt nose tools through a gate or riser on a heavy casting and expected to see it go up in smoke any minute, since Bill, as might be expected, had all the fuses plugged in his starting box.

Tom, the youngster who was in the last year of his apprenticeship, had his tools as nearly perfect, both as regards theory and practice, as one could wish. It was a real pleasure to see the chips fall from his roughing tools on either steel or iron castings. Compare Tom's type of roughing tool (*B*) with that used by Bill (*A*) and take your choice.



Correctly formed facing tool such as Tom uses

Tom had read up on the design and grinding of tools and was instrumental in having changes made in the system used in the redressing department. His roughing tools were either right- or left-handed, and were not compromises that could be used either way, such as many that the other chaps were using. Tom's chips were equal in width to the depth of the cut, and he always ran his machine and tool equipment at its most efficient speed. The steel chips falling off his roughing tools were a dark brown color. Tom's theory was that a blue chip was too hot and would cost more in the end for power and tool sharpening than a brown chip, but the bosses admired Bill's blue chips more than Tom's brown ones.

Skelly, a big ex-coalminer, on the 60-in. lathe, believed in plenty of lip and clearance. He wanted his tools to work freely and to have plenty of room all around. His idea of a

(*Continued on page 82*)

"How I Got that Better Job"

Announcing $60 in Prizes for Stories of Your Personal Experiences in the Shop

EVERY machinist and other mechanic has had experiences that parallel those Mr. Romig describes in this fascinating narrative. Mr. Romig's article is ideal for the Better Shop Methods Department. We want more articles like it.

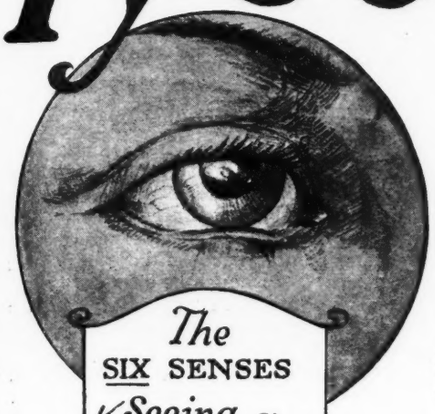
Therefore we are offering a first prize of $30, a second prize of $20, and a third prize of $10, for the three best contributions or letters of this nature, submitted on or before February 20, 1923. Contributions may be any length up to 3000 words. Others than the prize-winners may be purchased at space rates. Pencil drawings should be used to explain obscure points, and if photographs are available to illustrate the article, they also should be included. The subject must relate directly to better shop methods, and be told as a first-person narrative of shop experiences that may help or stimulate mechanics to achieve better workmanship through improved methods or the application of novel ideas.

The contest will be judged by the Board of Editors of this magazine, and announcement of the prize-winners will be made in the May issue.

Address contributions to Better Shop Methods Contest Editor, Popular Science Monthly, 225 West 39th Street, New York City.

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature control



The SIX SENSES
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Hearing ~
Smelling
Tasting ~
and ~ ~
Tycos
Temperature
Control ~ ~

If sense of "sight" satisfied the steel makers!

WHERE molten metal runs and splashes like milk—where the fierybroth shifts its flame-tints through violet, orange, pink, white and blue as it is "seasoned" with carbon, ferro-manganese, tungsten, ferrosilicon or vanadium—the practice in years gone by was to gauge the proper pouring temperature by observing the colors with the naked eye. The expert peered into the maw of that inferno, protected by colored glasses, and when he judged the time was ripe—out leaped the frenzied stream into the incandescent ladles! The result might or might not be good steel, of the proper grade for the purpose intended.

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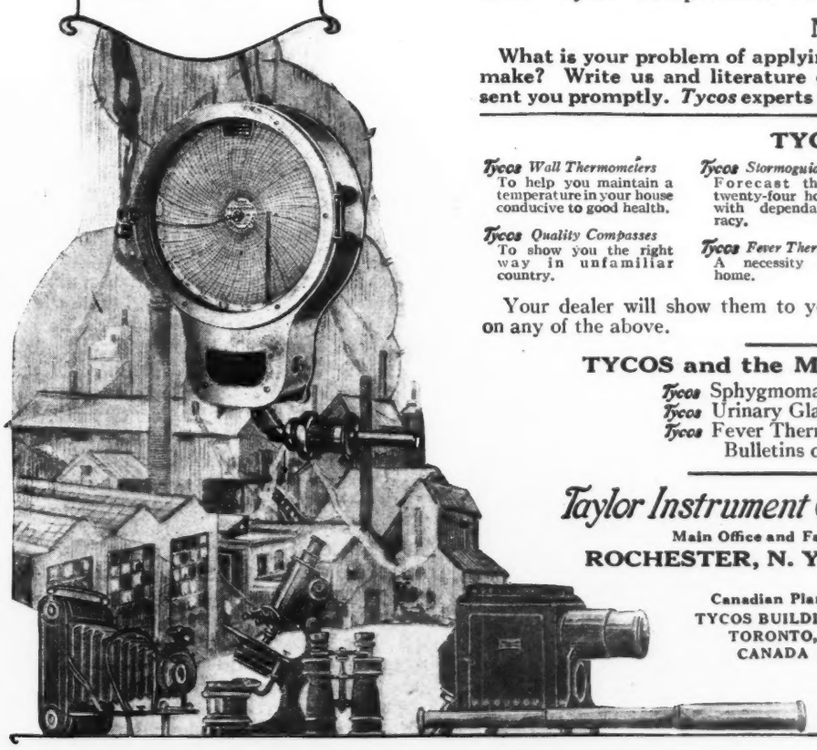

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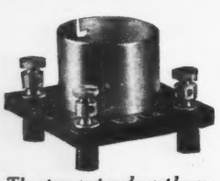

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BETTER SHOP METHODS

How Do You Grind Tools?

(*Continued from page 80*)

perfect roughing tool (*C*) was one in which the included angle of a tool's cross section, when viewed sideways, amounted to 60 degrees. He was a stickler on the redressing of tools and was known as "the pest" in the smith shop.

Skelly's idea was to make one big, heavy, rough cut, run at slow speed with a heavy feed—let her rip or bust. Many a time we marveled that his jobs stayed between the centers, with the tool, its front edge worn off, screeching a protest. After a readjustment of his centers and a fresh oiling, Skelly would put in a newly sharpened tool, speed up a bit, and knock a few notches in his feed. He was a genuine producer because of his tool and machine operating experience, his boldness, and what the boys called his "fool luck." Although he drew better pay than the average, he worked only half as hard as many on smaller lathes, his motto being, "Let the machine do the work."

Shorty, the "blatherskite" by nickname, could be heard all over the shop, at almost any time of the day, and so, too, could be heard his tools. If they were not screeching, they were chattering, just like the man himself. Shorty could make a tool cut even if it were ground with a negative clearance and no lip at all. Many a time have I seen him shim up a tool to give it the necessary clearance barely to cut. His idea seemed to be to do as little as possible and never more than was absolutely necessary to hold his job. His tools never needed redressing and seldom required regrinding, as they were always run under the most conservative speeds and feeds.

These Men Know Their Tools

Harry, the best of the lathe operators, was running an old tool lathe, most of his work being on tools and jigs. He had the largest assortment of tools in the shop, all in perfect condition, well sharpened, ready for instant use. He hated to dull a tool on a rough job and invariably advanced the argument that a better job could be made if the roughing was done on some other fellow's lathe. No man could borrow his special form of threading tools and consequently they were always in the pink of condition. Although he did beautifully accurate work in a reasonable time, he was thought to be a trifle too fussy.

Luther, the all-around man, could use any man's tools and make them work; he just ground them to suit his own taste. He could do a greater variety of work with fewer tools than any other man in the shop. For instance, he could true up an eccentric bore quicker than any of the rest of us. The cutting edge of his boring tool (*D*) stood at right angles to the central axis of the bore of the bushing. Thus when the heavy strain of the eccentric cut came down upon the bar, it merely depressed a trifle, and did not shove away like the tools used by the rest of us, who always thought a boring tool should be well radiused off.

The day I went into that shop and asked for a job as machinist, the red-headed foreman snapped, "Well, what can you do?"

"Oh, almost anything in a machine shop," I replied.

"You can, can you?" he shouted, above the din. "Ever run a lathe or a boring mill? Say," he continued, "can you sharpen a tool? Here, take this roundnose

(*Continued on page 83*)

BETTER SHOP METHODS

How Do You Grind Tools?

(*Continued from page 82*)

over to that wheel and let me see what you can do to it."

Returning in less than a minute, I handed him the tool, ground in my best style. He then barked, "Give you sixty an hour. When can you start?"

Later on this little red-headed judge of mechanics was forced to resign because of ill health, and it was he who recommended me as his successor.

Boys, how do you grind your tools?

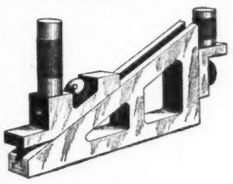
How Cutting Tools Act

REMARKABLE pictures showing the stresses to which machine tools are subjected in use will be published in a forthcoming number of POPULAR SCIENCE MONTHLY. The photographs were taken by so-called polarized light, and the beautiful color effects made by tools cutting into the work indicate graphically just how the stresses are distributed. This is an article no mechanic should miss.

Improved Planer Gage for the Machinist's Toolkit

EVERY machinist will find it worth while to add this planer and shaper gage to his toolkit. It has an end slide, as well as the regular slide, and both slide blocks are tapped for height blocks. This permits the gage to be used for two measurements at once and gives it an unusually wide range.

Complete working drawings of the tool are contained in a blueprint prepared by the Better Shop Methods Department. This can be obtained for 25 cents by filling out the coupon below. The blueprint also shows an optional scriber attachment that allows the tool to be used as a height gage.



Details of this unusually fine tool are contained in Blueprint A, prepared by the Better Shop Methods Department

A feature of the blueprint that is of particular interest to technical high schools, vocational schools, and other schools where machine shop practice is taught, is a series of thumbnail sketches that show how the work is laid out and the main operations performed. The making of the gage is an excellent project for such schools because of the accuracy required and the utility of the finished tool.

The slots are first sawed and then milled with a T-cutter after the work has been set parallel on the milling machine with the aid of an indicator. After the piece is pack-hardened, the slots are ground to size.

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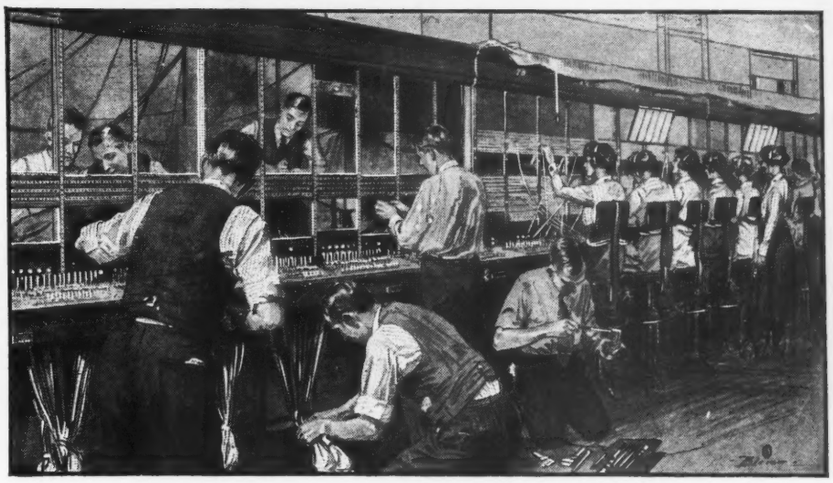

Expansion

A million new subscribers were linked to the Bell System during the past two years—putting into operation a million new routes of talk, and a corresponding increase in all intervening facilities such as switchboards, cable and long distance lines.

No other country is so well equipped as the United States for telephone communication. Yet, because of this—because the telephone is so useful—the demand for service keeps growing greater.

The growth of telephone demand in the United States is greater than the growth of population. It is an intensive growth. An increasing percentage of the population is seeking telephone service.

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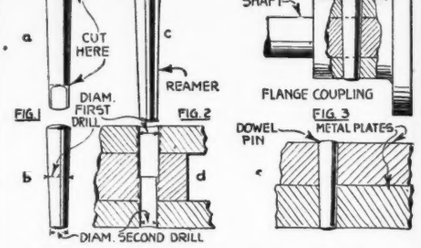
BETTER SHOP METHODS

Shanks Salvaged from Broken Drills Serve Many Purposes

THE shanks of broken or worn-out twist drills may be salvaged and used in many ways in the machine shop or factory. A number of the possible ways of using them are illustrated below.

Figure 1, *a*, shows the part of a taper shank utilized as a dowel or taper pin. To avoid excessive wear on the reamer in finishing the holes for these pins, two holes should first be drilled, one the diameter of the pin at its center, and the other the diameter of its small end, as shown at *b*.



How the drill shanks are cut and various uses to which they may be applied

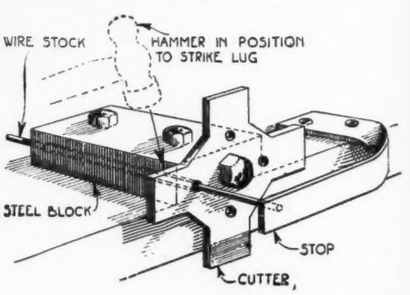
The larger hole is drilled halfway through from one side, and the smaller hole is then drilled through the rest of the way, so that there will be a minimum amount of metal to be removed by reaming.

When this has been done, as illustrated in connection with the metal lamination shown at *d*, Fig. 2, a reamer of the correct size, *c*, is used to finish the hole. Figure 3 shows a shaft and flanged coupling held together by the shank of an old drill, and at *f* are pictured two plates bonded together with a similar pin.—FRED S. HARGER, Terre Haute, Ind.

Hammer Blow Operates Wire Cutter for Radio Work

THIS wire cutter was devised in a Washington, D. C., shop that is constructing radio equipment. It consists of a steel block, attached to one end of which is a cutter which has four projecting lugs and four cutting holes. The lugs serve as striking faces for the hammer.

As the stock is pushed through one of the cutting holes, it strikes either a fixed or an



A time saving fixture where much wire cutting must be done

adjustable stop, as required. The cutter is then struck with the hammer to sever the wire. The end of the remaining wire or rod catches the next opening so that the operation may be repeated.

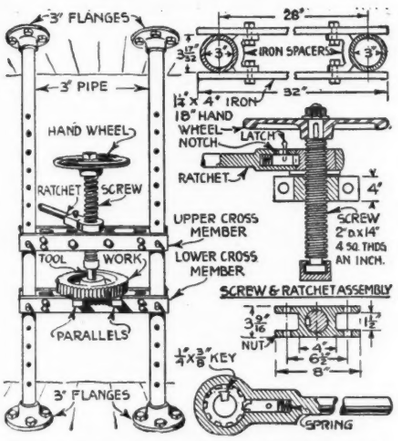
This is a simple device and for a hand operated tool cuts the stock quickly and smoothly.—F. L. M.

BETTER SHOP METHODS

Easily Built Press for Garage Handles Wide Range of Work

ONE of the most essential tools in the garage is a press upon which tight gears, sleeves, bushings, and the like can be set in place. In order to handle a large variety of work, the press must be quite large. The trouble with many commercial presses is their short vertical range.

The cheap and rugged press that is illustrated has a wide range and can be built with little difficulty. The main standards are 3-in. heavy pipe fastened to both floor and ceiling with 8-in. floor flanges. The pipes are drilled as shown for pinholes before assembling. The standards should be plumbed carefully when they are put in place. The cross members are built up of 1¼ by 4 in. bars of flat iron, which can be obtained from any hardware store dealing in blacksmith supplies. Iron spacers can either be bent up out of flat iron or castings made from a simple pattern. These hold



This sturdy press, with its pipe standards and simple parts, can be built at small cost of materials

each pair of cross pieces apart the correct distance and also form a rough bearing that slides against the uprights. They are fastened to the cross pieces with short ½-in. bolts.

At the center of the upper cross piece is the nut, fastened with bolts that run clear through the whole assembly. This nut should be a bronze casting, although an iron nut can be used. The screw is turned up from good machinery steel to the size shown. The bottom end carries a swivel foot that remains stationary when the screw turns. Between the end of the screw and the inside swivel block should be placed a bronze disk to take up the pressure and allow the screw to turn freely.

The screw is turned by means of a ratchet device, illustrated in detail. The power applied to the handle is transferred through the slotted bushing and a key to the screw, as shown. The hand wheel on top is for setting the machine quickly and can be used for work that does not require any great pressure.

The ratchet, which works only in one direction, can be thrown out of action by pulling the latch back and turning it into a slot. This allows the screw to float free from all the parts. Parallels of square steel are used to support the work.—R. J.

WHEN tempering work to a light straw color, always have a brightly polished piece of steel for comparison, so that the eye notices the least change in color.

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Dentists, the world over, have declared a war on film. That is the cause of dingy teeth—the cause of most tooth troubles.

A viscous film clings to the teeth, gets between the teeth and stays. Old brushing methods left much of it intact. Then it formed the basis of thin cloudy coats, including tartar. Most people's teeth lost luster in that way.

Film also holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay. Germs breed by millions in it. They, with tartar, are the chief cause of pyorrhea.

Very few people have escaped these troubles caused by film.

Ways to combat it

Dental science, after long research, has found two ways to combat that film. Able authorities have amply proved their efficiency. So leading dentists the world over now advise their daily use.

A new-type tooth paste has been created, avoiding old mistakes. The name is Pepsodent. It does what modern science seeks. These two great film combatants are embodied in it

Aids nature's fight

Pepsodent also multiplies Nature's great tooth-protecting agents in the mouth. One is the starch digestant in saliva. That is there to digest starch deposits which cling to teeth. In fermenting they form acid.

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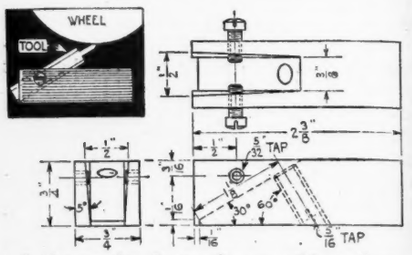
BETTER SHOP METHODS

Threading Tool Held at Correct Angle for Grinding

THIS tool holder for grinding threading tools on a surface grinder is so simple that one can easily be made in half an hour. It holds the tool in such a way that not only is the threading angle properiy formed, but



A time-saving fixture for use with surface grinder

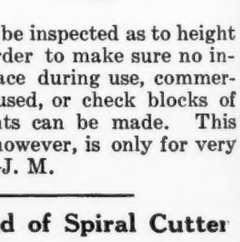
the correct clearance is provided at the same time.

One setscrew is used to clamp the tool when one face is being ground, and the other when the opposite face is presented to the wheel. The setscrew not in use is withdrawn far enough to permit the tool to lie flat against the angle-determining face.

Another setscrew passing up through the bottom of the holder makes it possible to set angles other than 60 degrees.—S. L. R.

Bench Height or Sizing Gage Serves Many Purposes

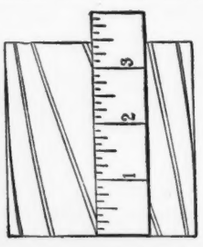
A SIMPLE and effective sizing gage is shown in the illustration. It consists of two cast iron blocks between which goes a regular scale, or, if preferred, a piece of steel marked off to serve as a scale. It will be noted that the scale is fastened to the two blocks by two flat head screws. A sizing member *A* is held by a small screw at any position.



This type of height gage is particularly useful where numerous pieces have to be inspected as to height and width. In order to make sure no inaccuracy takes place during use, commercial gages can be used, or check blocks of the common heights can be made. This latter expedient, however, is only for very particular work.—J. M.

Finding Lead of Spiral Cutter

TO FIND the lead of a spiral milling cutter, place the cutter on the marking-off table or surface plate and apply an ordinary scale, as shown. Place the scale at the end of one tooth and note the distance where the edge of the scale cuts the line of the next tooth. Multiply this distance by the number of teeth and it will be very close to the lead.



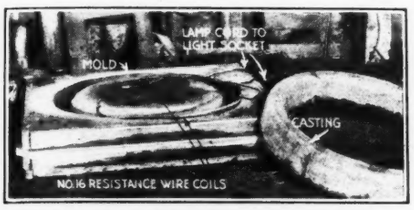
The sketch shows a lead of 30 in. figuring 3 in. for one tooth for a ten-tooth spiral.—F. H. SWEET.

BETTER SHOP METHODS

Heated Resistance Coil Quickly Dries Sand Molds

A RESISTANCE coil provides a quick and inexpensive method of drying sand molds just before pouring in the molten metal. The mold illustrated was used for casting a ring from an alloy composed of 80 per cent nickel and 20 per cent chromium—metals used for the heating element in nearly all electrical heating devices.

A ½-in. spiral of No. 16 nickel-chromium wire was cut the right length to fit the



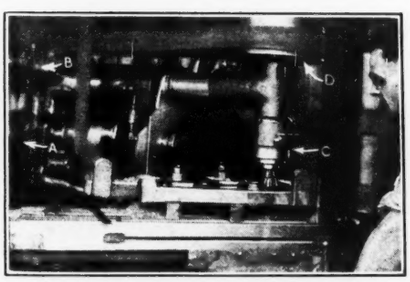
Mold is heated by electricity instead of being baked

depression in the mold and connected with lamp cord to an ordinary electric-light socket. The depression in the mold is 6½ in. deep, 5½ in. across the top, and 44 in. in outside diameter. If a stock of resistance wire is kept on hand, it can be made up into ½, ¾, or 1-in. coils at odd times and these can be cut to a length that will fit any size or shape of mold.

The coil is simply dropped into the depression, the electricity turned on and the mold covered with firebrick to confine the heat. The advantages over the method of baking molds in ovens are that heat can be applied directly to the casting surface of the molds; no heat is wasted in drying out the parts of the mold that are not required; wooden flasks and bottom boards are not dried out and burned; savings are effected in the labor and time of carrying molds to and from baking ovens, and the mold can be kept hot until the moment the melt is to be poured.—E. F. LAKE, Detroit, Mich.

Quick Change Milling Machine

TO THE end of a regular milling machine spindle an ordinary 8-in. pulley (*A*) was fastened. In the hole usually occupied by the overarm was placed a bracket carrying two idler pulleys, one of which is shown at *B*. A vertical spindle (*C*) was supported



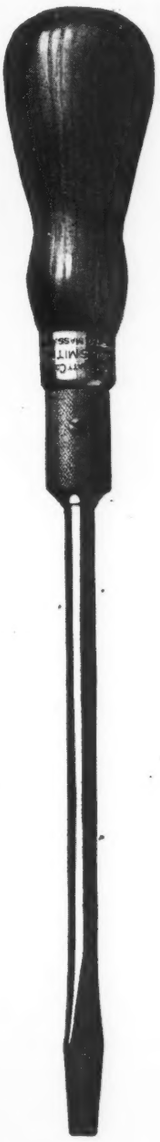
Vertical spindle on horizontal miller

on the regular overarm of the machine. This vertical spindle had a pulley (*D*).

The main belt drives the regular spindle and this turns pulley *A*. The extra belt fastened around *A* and over pulleys *B*, drives the pulley *D*.

The complete outfit, costing $10.50, can be changed from horizontal to vertical or vice versa in 10 minutes.—J. H. MOORE.

"WANTED— Some jobs for this screw-driver"



Ratchet Screw-Driver
No. 66

Changes from right to left made by turning the knurled Ferrule. Blades range from 1-1/2 inch to 10 inches in length. Prices run from 90c each for the former to $1.50 for the latter.

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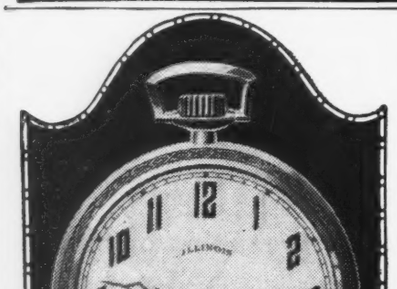

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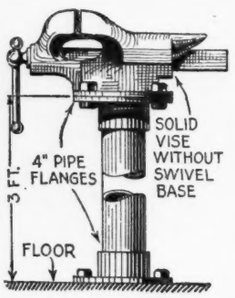
BETTER SHOP METHODS

Heavy Pipe Used as Mounting for a Fixed Vise

AN IMPROVED method of mounting a vise for general purposes in the shop is shown herewith. The pedestal is a short length of 4-in. wrought iron pipe, with two flanges. One of the flanges is bolted to the floor, while the other forms the supporting face for the vise.



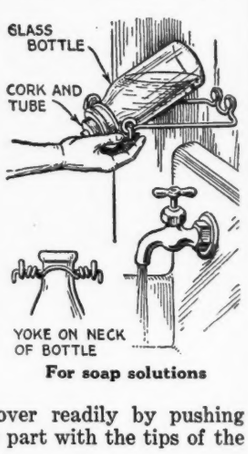
A sturdy pedestal vise

The advantage of this vise is that the mechanic can work without restrictions on all sides of the fixture, in the most convenient position and the best light. Where hammering or riveting is to be done, the metal base affords a more rigid support than if the vise were mounted on the top of a wooden bench.

Apart from these advantages, the mounting is relatively inexpensive to install.—A. J.

Bottle Dispenses Liquid Soap in Shop Washroom

A LIQUID soap dispenser suitable for the shop washroom can quickly be made from a short bottle of as large a diameter as can be found. The cork is provided with a spout made from a short tube. A yoke of wire is then twisted around the neck of the bottle and suspended from a stiff wire bracket attached to the wall above the faucet. The yoke pivots in such a way that the bottle normally hangs upright and yet can be tipped over readily by pushing against the lower part with the tips of the fingers.

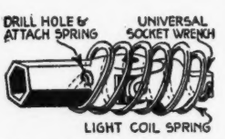


For soap solutions

Liquid soap can either be purchased or made by shaving up brown soap and dissolving the slices in boiling water.—E. L. F.

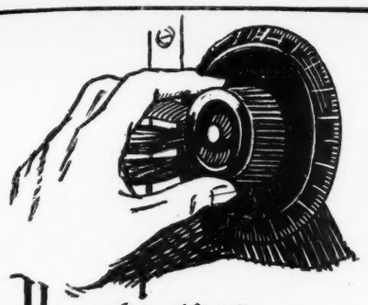
Stiffening Universal Wrench Joint

WHEN socket wrenches with a universal joint are new, the friction between the parts is sufficient to make a connection that will remain stiff when the wrench is being used. When the wrench becomes somewhat worn, however, the joint tends to loosen and the socket wabbles.



Spring holds joint firmly

To overcome this objectionable feature and yet allow the joint sufficient flexibility to serve its purpose, it is necessary merely to place a light coilspring about the parts, as illustrated. One end of the spring is attached to the wrench handle so that it will not slip off.—G. R. Y.



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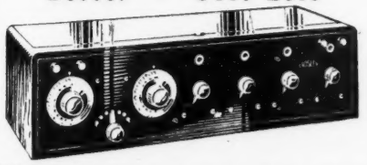

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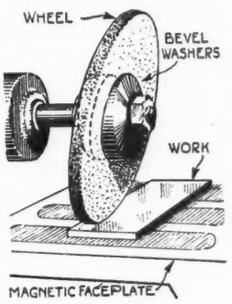
BETTER SHOP METHODS

"Wabble" Wheel for Surface Grinder Prevents Glazing

THE "wabble" saw for increasing the width of cuts is an old idea that has increased production in cutting slots and key seats and doing other work on the milling machine without using the transverse feed on the table. Following this same plan, a wabble wheel on a surface grinder has recently been tried in a large machine shop for grinding the surface of steel instrument springs. The results proved to be unexpectedly favorable.



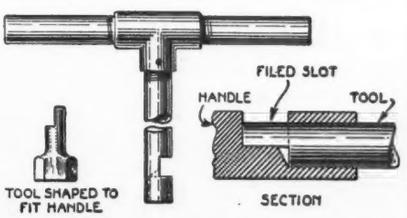
Beveled retaining plates such as are used for the circular steel saw, hold the abrasive wheel on the mandrel. The wabble or offset corresponds with the width of the material to be ground, or slightly in excess of that. The fore and aft movement of the machine table is not used, as ordinarily, and the material is fed slowly forward, the entire surface grinding being accomplished by the work passing only once under the wheel.

In this work the wheel holds up as well as it would do when running true. A noticeable feature was the absence of glazing on the wheel surface. The fanlike action of the wheel keeps the heat down and permits a heavier cut to be made than was possible with a true wheel. By making a comparison between the costs of production before and after the wabble wheel was used, the saving in time was found to be about 25 per cent.—P. L. K.

Broken Tools Saved by Means of Detachable Handle

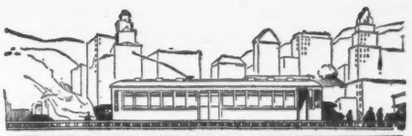
A DETACHABLE handle for many tools can be made very simply by the method illustrated. This consists of drilling into the end of the piece of steel selected for the handle a circular hole and filing just at the end of this hole a cross slot half through the section, as shown.

To prepare the tool for this handle, it is necessary only to file or grind a half section at the end. When the tool is inserted in the socket, the end lip seats on the shoulder and forms a firm bearing for holding it.



This simply made handle gives considerable leverage for screwdrivers and other tools

Broken tools, such as socket wrenches, drills and screwdrivers, can often be salvaged by this means. The fact that the handle is detachable is an advantage because it can be used for several tools, and the work of making it up requires only drilling and filling.—M. R. C.



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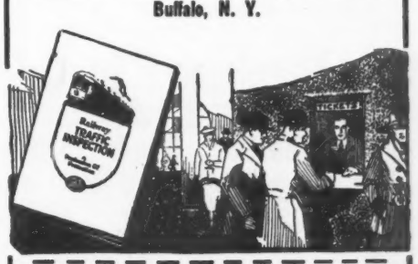

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Will There Be a $150 Car?

(*Continued from page 27*)

tools and manufacturing processes. Special machines have been designed and redesigned to turn out parts at great speed. The latest drill press drills 100 holes at once. A dozen flywheels are finished at a time. Year by year, as improvements have been introduced, the price of Fords has dropped. Is it not reasonable to assume that manufacturing processes will continue to improve as they have in the past, resulting in still greater production and still lower prices? Certainly the suggestion that the $150 car will eventually be produced by Ford, Durant or some other maker sounds fully as reasonable as did Ford's announcement in 1907 that he would build a four cylinder runabout.

The $150 car, when it arrives, cannot be noticeably smaller than the present Ford or Star, but it certainly will be lighter. One thousand pounds is a logical weight. In design it will not be radical, although short cuts in arrangement of parts will keep the weight down and lower manufacturing expense. In Europe cars within this weight limit are now being built to carry three or four persons. These cars are unusually small, yet most of them are well equipped with four cylinder water-cooled engines, clutch, three-speed transmission, electric starting and lighting. The engines have a bore of from two to 2½ inches, a stroke of from three to four inches and they develop from 10 to 20 horsepower.

Some Features of "Every Man's Car"

The rapidly increasing popularity and practicability of air cooling indicates that this form of cooling would be used in the $150 car. Other features of the "every man's car," as I picture it, would be: a wheelbase of 100 inches, a tread little less than standard, 28 by 3 tires, a four-cylinder engine of 2 by 4 inch inside cylinder measurement and cooled by blower and air jackets, splash lubrication, clutch, and two speed transmission.

The engine would develop about 15 horsepower, propelling the car at a speed of more than 40 miles an hour. It would run 60 miles on a gallon of fuel and 1000 miles on two quarts of oil. This oil consumption is figured on the plan that the crankcase would be drained every 1000 miles and filled with new oil.

A car of this design should run 10,000 miles on tires that should cost no more than five dollars each. If appearances were no object, tires smaller than the 28 by 3 size would be sufficient for a 1000-pound car. The complete cost of operation, including depreciation and repairs, would be just a trifle more than one cent a mile—1.27 cents to be exact. The expense items on a mileage basis would be: gasoline, .5 cent; oil, .05 cent; tires, .2 cent; repairs and depreciation, .516 cent.

To minimize cost of units, side frame members, runningboard, and runningboard aprons might be combined into a single unit. Body sides might be designed to take the place of the frame; the hood, cowl, and false radiator might be pressed from a single sheet of metal, access to the engine being obtained by lifting the entire covering unit from the front. Certainly the practice of placing a conventional body of sheet metal on a carefully built frame would be discarded, possibly in favor of a body of compressed cotton and glue such

(*Continued on page 91*)

Will There Be a $150 Car?

(*Continued from page 90*)

as Ford is experimenting with. Floors would be of wood, the windshield a single piece of glass, and the top designed possibly along the lines of a seashore umbrella. Disk wheels of a single sheet of metal would be used. Various parts forming the body would be enameled as manufactured so that the car when assembled would not require painting.

The power plant and all its adjuncts would form a single unit, the engine being so small that a kick starter like that used on a motorcycle would be sufficient. The storage battery, generator and gasoline tank would all be in unit with the engine. Thus, when repairs were required, the nuts holding the engine to the chassis would be removed, the universal joint disconnected, the hood tilted back, and the engine would be lifted out easily. A very small storage battery would be sufficient because of the comparatively small lights and the elimination of the starter.

That such a car is a future possibility at a price of $150 is proved by comparison with the present Ford. The Ford runabout retails at $269. The average Ford dealer buys it for about $228. From this figure deduct the manufacturer's profit and taxes which, according to most recent statements, amount to $69. Thus the net cost of manufacturing is $159, or about 10 cents a pound, figuring the weight at 1600 pounds. On the basis of the same manufacturing cost a pound, the total cost of the $150 car, weighing 1000 pounds, would be $100, leaving $50 for sales profits and expense.

Where Savings Might Be Made

Indeed, it is very probable that the cost a pound could be reduced below that of the Ford by important savings. The engine of the $150 car, for example, would require only one third the machining that a Ford engine does. The cost of a small generator and battery could be balanced against the cost of the Ford magneto. The body and top construction would be simpler. There would be only seven gears in the transmission as compared with 12 gears in the Ford transmission. The Ford has a multiple disk clutch that well might be replaced by a single disk clutch. Three ignition coils could be discarded.

Figures on the possibilities of quantity production are even more inviting. Assuming that the low price of $150 would be attractive enough to create 20,000,000 new car owners and that the average life of the car would be four years, continuous production at the rate of 5,000,000 machines yearly would be possible. And such an assumption is not an exaggeration when we consider the fact that of the 110,000,000 persons in the United States, 10,000,000 already own cars. After 20,000,000 new owners were supplied with cars, an annual production of 5,000,000 would be required to replace worn out machines.

With the assurance of such tremendous production and rapid turnover—the $150 car would almost certainly sell itself over the counter, and present expensive selling methods would no longer be required—the margin of $50 a car for gross profits and taxes, already mentioned, should be entirely adequate for the manufacturer.

Systematic salvaging of "worn out" cars would be possible. At present only about 25 per cent of a car that is junked is really

(*Continued on page 102*)

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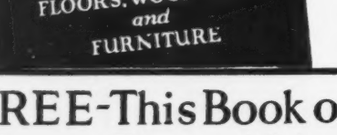

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The Home Workshop

(Continued from page 78)

Snug Log Cabins and Bungalows

By F. E. Brimmer

DURING cold weather is the best time to build log shelters, because then the sap has retreated into the roots. Any soft wood trees with straight trunks may be used, but the best are spruce, balsam, pine, hemlock, fir, tamarack, and poplar. The most convenient sizes range from 8in. to 1 ft. in diameter.

There are four types of log shelters that may readily be constructed. The most simple is the shack, usually with one room and no chimney or porch, small and built solely for protection against the elements. The logs stand vertically and the roof is peaked. The log cottage is a little larger and has a chimney and fireplace, a gable roof, and a porch. The logs may be either upright or horizontal or the walls vertical and the gable ends horizontal, or vice versa.

The log bungalow is ordinarily a warm weather abode, usually with dormer windows in a roof of peaked or hip style and large porches. The true log cabin is built ordinarily with horizontal logs and the roof is of the lean-to type.

Few tools are needed to build a simple log shack or cabin. An ax will do all the cutting, but a buck- or hand-saw will make the work easier for the amateur. A 2-in. chisel will aid in making mortise and tenon joints, shaping notches, and fitting door and window frames. A single bit ax is the handiest because it can be used for pounding pins into place. A crosscut saw will help in felling very large trees.

The most popular foundation is made by resting the sill timbers upon cedar posts that extend into the ground 2 or 3 ft. The sills may safely rest directly upon rocky ground or hard clay, or large stones may be placed at the corners and at intermediate distances under the sills.

When the sills have been cut, chop two opposite faces flat like a railroad tie, saw off the ends at a bevel of 45 degrees, and spike together upon the foundation. The method of securing the sleepers from sill to sill is shown in Fig. 1. They are placed every 3 ft. for a board floor and 4 ft. for planks.

The log frame of the typical small Adirondack shack is shown in Fig. 2. Four corner posts 6 or 7 ft. long are toe-spiked to the sills and then plate logs are spiked to the tops. After this the wall logs are cut to the proper length and spiked in place between sill and plate.

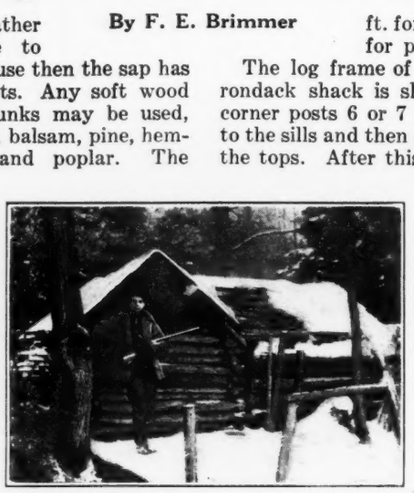
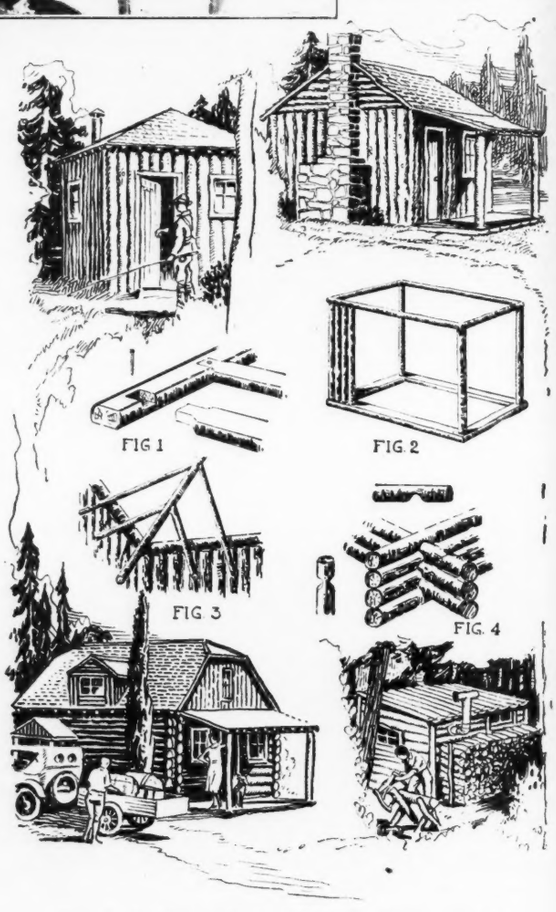


Fig. 3 shows the method of building the roof. From each corner a beam extends to the peak, and each rafter, where it fits over the plate log, is notched and spiked in place. The small jack rafters are spaced 2½ ft. apart along the plate. Cover them with 1-in. boards and shingle the roof or lay heavy roofing paper.

In case a cabin with horizontal logs is built, the corners should have the notches downward to shed the rain, as shown in Fig. 4.

To fill the spaces between the logs, cotton waste or oakum should be pounded into place with a mallet and blunt stick.



Four typical log shelters and details of construction

THE HOME WORKSHOP

Building an Ideal Bench

(*Continued from page 75*)

the separate pieces were given to the mill to cut the stock to dimensions. Since maple is exceedingly hard, it is not advisable to attempt to saw it by hand. If maple cannot be obtained easily, beech or birch will do very well and other hard woods may be used, although maple, beech, and birch are practically standard for bench tops. An excellent method of making the top is to use a number of narrow tongued and grooved strips bolted together, but a well-seasoned, solid plank will serve every purpose and does not require as much work to prepare.

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The framework is fastened together with lagscrews or bolts. The back portion of the top, containing the recess, is attached as a unit to the solid plank in front by lagscrews and dowels. The lagscrews pass through the end blocks, which are bevelled so that shavings and dust may readily be swept out of the depression.

The 2¼ by 2¼ in. muntin between the drawers and the small door at the left are lagscrewed to the front rails at the top and bottom, the heads of the lagscrews being sunk into the top rail. The top is attached either with ¼ by 4 in. lagscrews, through the rails from underneath, with the heads countersunk, or by means of blocks screwed to the inside of the rails and to the under side of the top.

A woodworking vise

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(*Continued on page 94*)

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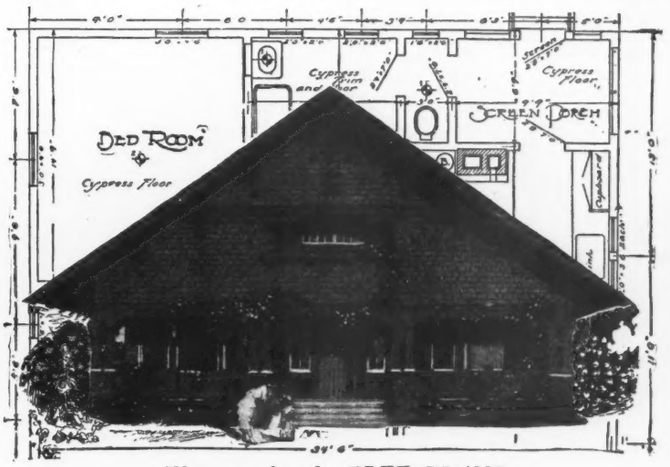

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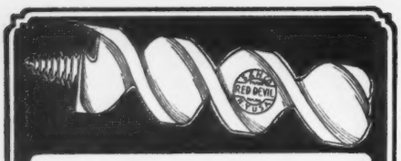

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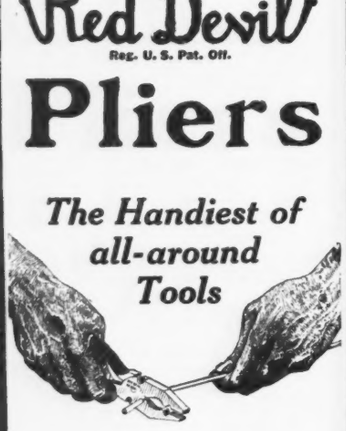

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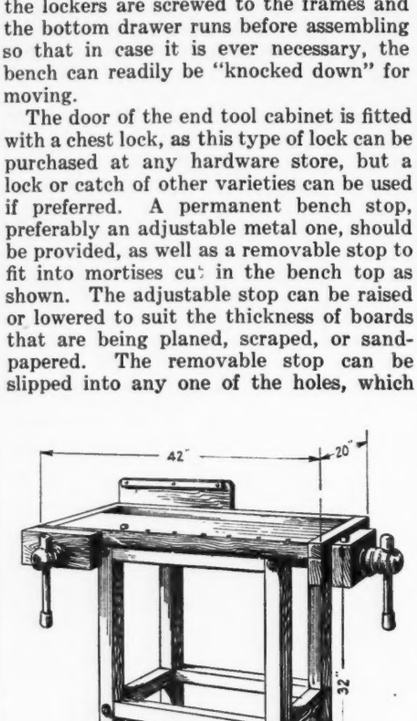
THE HOME WORKSHOP

Building an Ideal Bench

(*Continued from page 93*)

place as the parts of the bench are bolted together. The ⅜-in. linings at the sides of the lockers are screwed to the frames and the bottom drawer runs before assembling so that in case it is ever necessary, the bench can readily be "knocked down" for moving.

The door of the end tool cabinet is fitted with a chest lock, as this type of lock can be purchased at any hardware store, but a lock or catch of other varieties can be used if preferred. A permanent bench stop, preferably an adjustable metal one, should be provided, as well as a removable stop to fit into mortises cut in the bench top as shown. The adjustable stop can be raised or lowered to suit the thickness of boards that are being planed, scraped, or sandpapered. The removable stop can be slipped into any one of the holes, which



Small bench with end vise

should be ⅞ by 1 in., ⅞ by ⅞ in., or ¾ by ⅝ in., according to the stop. It is advisable to buy one before cutting the mortises, since the stops come ⅞ by ⅞ by 8½ in., ⅝ by ¾ by 6¾ in., ⅞ by ⅞ by 4 in., ⅞ by 1 by 7½ in., and other sizes.

Metal woodworking vises can also be obtained in many styles and sizes, one of which is illustrated.

The bench should be finished with two or three thin coats of shellac or rubbed with genuine boiled linseed oil. Sometimes commercial benches have an oil finished top and shellacked frame, and this combination can be used if preferred. Although benches are almost invariably finished in the natural wood, occasionally fine benches and tool cabinets intended for use in the home are stained.

For one who already has a toolchest or tool cabinet, the drawers and lockers probably will be unnecessary and they may be omitted and left to be installed at a later date when new tools make necessary an additional storage place. Other modifications may be made, such as omitting the drawers and lockers, or making a large locker with double doors in the space occupied by the three drawers.

A bench of a simpler type is the one shown above with two vises. It is 42 in. long, 20 in. wide, and 32 in. high—somewhat smaller than the cabinet bench. It is bolted together, the nuts of the bolts being inserted in large holes bored in the rails so that they can be held firmly while the heads are turned up with a socket wrench. The wooden vises are considerably cheaper than quick-acting metal ones. The extra one

(*Continued on page 95*)

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THE HOME WORKSHOP

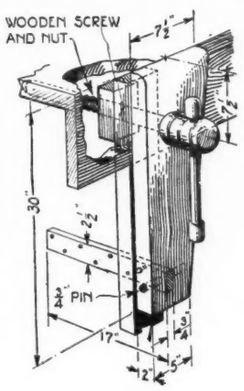
Building an Ideal Bench

(*Continued from page 94*)

at the end is useful in cabinet work and serves as a substitute for the regulation end vise found on cabinetmakers' benches.

Another simple bench to build is the small carpenter's bench shown in the lower right-hand corner of page 75. This has an old-fashioned vise, which really is a very useful and sturdy vise for general utility work because of its size and wide range. All that has to be purchased to install such a vise is what is known as a wood bench screw, a wooden vise screw, a wooden or metal nut, and a wooden vise handle. The screws are usually either 2 or 2½ by 24 in.

The method of making up and attaching the vise is shown in detail. The arm at the lower end is a sliding fit in a mortise in the leg of the bench or in a block attached to the leg. A pin or peg—a 20-penny nail will do nicely—is pushed through one of a series of holes to adjust the arm according to the thickness of the work that is to be clamped in the vise. If, for instance, a box is to be held in the vise, the arm is pulled out the distance necessary to allow the vise jaw to remain parallel with the apron on the bench. This apron should be 10 or 12 in. wide and have holes bored at regular intervals in it to take pegs used to support one end of long planks being planed or otherwise worked.



A wooden vise

Better than this bench for fine cabinet work is the professional cabinetmaker's bench, also illustrated on page 75. This is a long bench with an L-shaped end vise.

If no room at all is available for a bench, a bench attachment may be made for the kitchen table (see the illustration in the lower left-hand corner of page 75). This is merely two planks screwed together at right angles to each other, as shown.

A discarded bedstead provided the legs and lower rails of this bench made by Herbert A. Mincher, Youngstown, Ohio

A block with a V-shaped notch is screwed to the top to serve as a bench stop and a vise is attached to the apron as shown.

The attachment can be stored in a closet or behind a door and when needed it is simply placed on the kitchen table and held with a C-clamp at each end.

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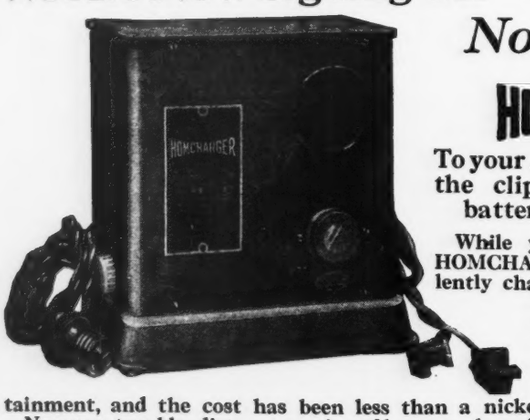

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Crokinole-Carom-Checker Board

(*Continued from page 76*)

will not cut through the board the first time you run your knife across it, and probably not the second time, but it is not necessary to cut it entirely through. After you have cut it halfway through, bend the piece over, and it will break along the line of cutting. The rough, broken edges can be smoothed with sandpaper or a file.

When you have cut the corner pocket openings out of the piece *A*, prepare the center circular piece, *B*, Fig. 3. The best compass for drawing the circles on this piece is a strip of cardboard with a pin or brad stuck through it near one end for a center, and holes punched at the correct radial distances, through which to insert a pencil point. You will notice that there is a center circle 1¼ in. in diameter; the wallboard inside of this circle is to be cut out. Then there is a circle 8 in. in diameter around which the holes for eight pegs are to be located. The two outer circles should not be drawn until the board has been assembled and painted.

The pegs must be fastened in board *B* before it is glued to board *A*, because these pegs are roofing nails, *D*, Fig. 4, that run through the board from the under side. Plumber's ⅝-in. fuller balls, *E*, used for faucets, are glued to the nail ends. The large heads of the roofing nails must be set flush with the under surface of the board, therefore you must cut away the wallboard to form pockets of the right size to receive them. Space the pegholes equidistantly. You may find the holes in the fuller balls too large for the nail ends, so first wrap strips of paper coated with glue around the nails.

Fig. 4 Pegs

Carpenter's hot glue is best for fastening the two boards together, but lacking this you can use liquid glue. The glue must be thin enough to spread readily, and it must be coated on the surface of each board. As soon as it is applied, bring the surfaces into contact, place the boards flat upon the floor or a table, and pile enough books or other weights on top to keep the surfaces in close contact until the glue has set. Board *B* must be centered exactly on board *A*, and it must be turned so that a pair of the pegs *E* are parallel to each edge of board *A*, as shown in Fig. 3.

Gluing the Rims

When the boards have been glued up, prepare the rim strips, *C*. These must be grooved to receive the edges of board *A*. The grooves are easily cut with a ¼-in. chisel. The ends of the strips are mitered to join like picture frames. Be careful not to trim them too short, for the board will then spread the joints. Coat the edges of the board and the grooves with glue, set the board in the grooves, and glue and nail the mitered strip ends.

The boards require several coats of enamel. Enamel the rim strips and the circular playingboard red, the balance of the surfaces on both sides of the board yellow. When the enamel has dried, describe the circles on the circular board as located in Fig. 3. These circles can be drawn first in pencil; then with a small brush and black

(*Continued on page 97*)

Best Home Workshop Ideas Win a Bonus

THE January "Best Idea" prizes are awarded as follows:

FIRST PRIZE. $15: **Joe V. Romig,** Allentown, Pa., "'Universal' Machine Gives Wide Range of Service" (see page 78).

SECOND PRIZE, $10: **L. C. Porter,** Cedar Grove, N. J., "Every Room in the House Wired for Radio and Call Bell" (see page 106).

The prize-winning articles, as will be noted, are original and essentially practical. Mr. Romig, in designing a simple, general utility machine for the home machine shop, has performed a real service. It is hoped that other readers ill contribute material of equal value in regard to small, inexpensive machines for the home workshop.

Remember that these prizes are awarded each month and are a bonus given in addition to space rates.

Crokinole-Carom-Checker Board

(*Continued from page 96*)

paint go over the lines, making strips ⅛-in. wide. On the outer circle you will see four short lines. These divide the crokinole starting line so that each player will know his bounds. Locate the points by drawing diagonals through the corners of the board.

Figure 2 shows how to lay out the checker board. Mark off the checker squares with a pencil, then fill in alternate squares with red paint, and the remaining squares with black paint. The line outside of the checker board field is the starting line for the game of caroms and other games.

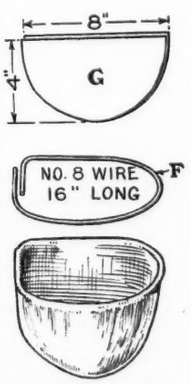

Fig. 5. The pockets

The corner pockets, Fig. 5, have heavy wire frames, *F*, to fit the grooves in the rim strips, and are curved to suit the circular openings. The pockets are made of two pieces of light weight cloth cut like *G*, Fig. 5, sewed together around the edges and hemmed at the top.

The crokinole and checker disks are cut from a curtain or rug pole 1⅛-in. in diameter, *H*, Fig. 6. Mark off 7/16-in. spaces along the pole, then cut the disks carefully along the lines. Any disk found to be too thick can be rubbed down to the right size with sandpaper; those too thin should be discarded. Twenty-four perfect disks are required, and it is best to make several additional ones to replace any that may be lost. Enamel one half of the number of disks red, the other half black. The disks should be smooth, so they will slide over the board's surface. If they are rough, sandpaper the paint lightly and apply another coat.

Fig. 6. Checkers and crokinole pieces

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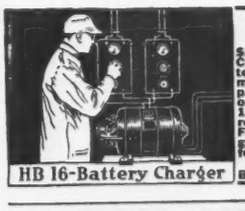

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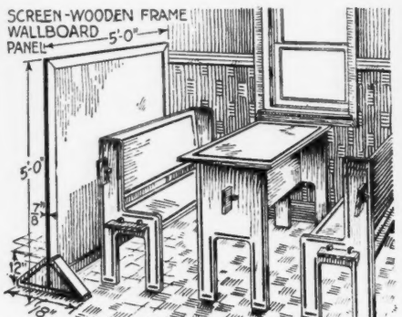
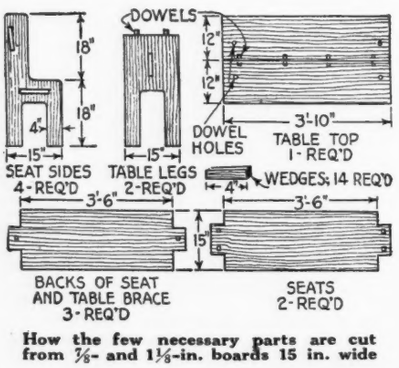
For the space for the table and benches I chose a corner of the kitchen lighted by a large window. It was shut off from the rest of the kitchen by a portable frame covered with heavy wallboard, used to form an alcove.



The tenon and wedge construction makes it possible to take apart the benches and table for moving

Two long benchlike seats were made in the plainest possible manner by pinning a seat and a back to two side pieces with wedges, as shown. The table was made in a similar fashion, a top being screwed solidly to the legs and the whole braced by a center rail. Tenons at the ends of the rail pass through the mortises in the legs and are held by wedges in the same manner as the seat members.

Plain white pine was used throughout, the stock being 1⅛ in. thick except the bench ends, which were 1⅜ in. and the screen frame, ⅞ in. The blocks at the base of the screen were heavier stock for the sake of stability. The entire nook was painted cream white with a simple blue border on the edges of the seats and table.



How the few necessary parts are cut from ⅞- and 1⅛-in. boards 15 in. wide

Not only has the arrangement proved a great convenience, but it also has the additional advantage of being readily removable in case of necessity.—G. L.

More Uses for Old Tire Tubes

THE soles and heels of shoes can be saved by cementing inner tube rubber on them. Use strips around doors and windows where there are drafts. Fasten a piece on a rod to make a window cleaner. Tack a strip down at intervals on a smooth board for a neat rack for small articles.—F. N.

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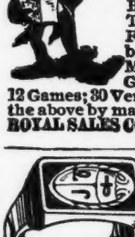

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Don't Blame It On Static!

The Real Explanation of Much of the Trouble You Have with Your Radio Set

By J. C. Shaw

One of the things which the radio world is rapidly learning is that the term "static" has been very loosely used to cover a multitude of radio sins for which static is really in no way responsible.

It is discovering that many of the frying, crackling noises and much of the so-called interference laid at static's door are due to nothing more or less than *the use of batteries of the wrong kind or that leak an excessive amount of electricity.*

Any one of these battery faults can undo the most careful work in construction of set and aerials, and usually not only one but two or three of them are present in the same place.

Radio operators should remember particularly that "B" batteries are in series with the phones or amplifying horn and that any noises set up within the "B" batteries themselves will come in strong. You can demonstrate this to yourself by scratching your "B" batteries with your finger-nail. The noise you get through your phones will surprise you.

A growing understanding of these facts is leading to much greater care in the selection of batteries and to the use of high-grade storage batteries for both A and B work, since such storage batteries have just the characteristics needed for both efficiency and economy in radio service.

An interesting development in this connection is the new type of "B" battery and an all-rubber "A" battery put on the market by the Willard Company. In these batteries, electrical leakage, which is present to such a great extent in the ordinary battery and which accounts for so much noise, is to a great extent ingeniously overcome.

The "B" battery cells are cylindrical glass jars with hard-rubber, screwed-on covers. These are so spaced that the only contact between cells is through heavy, burned-on connectors. No sealing compound is used and the box is cut down so that the sides reach up only about half way to the tops of the jars.

These features and the use of threaded-rubber insulation, operators find, result in a battery which holds its voltage, is never sluggish and, with occasional recharging, lasts for years. The writer has seen this Willard "B" battery in use on different sets and has been greatly impressed with the way in which it adds to range and power, and cuts out noises.

Inasmuch as this big improvement can be effected at an actual saving of money because of the long life of a really good storage battery, there is no question that this type of battery will rapidly be adopted for a great majority of sets. When this is done, the bugaboo of "static" will lose much of its terror.—(Advertisement.)

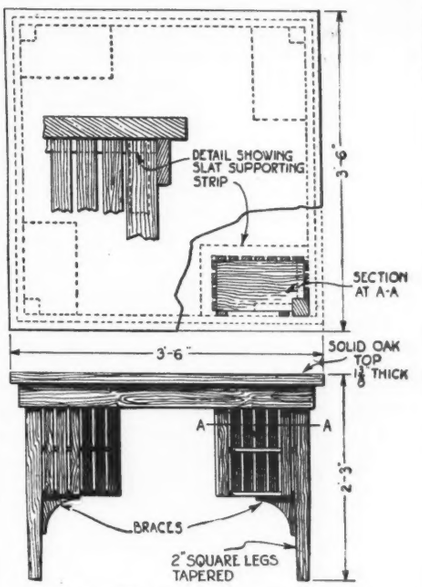
THE HOME WORKSHOP

Children's Study Table Makes "Home Work" a Pleasure

By Dale R. Van Horn

THIS study table is especially adapted to the needs of the average family in which from two to four growing children require a convenient and somewhat secluded place for doing their home lessons in the evening. Each of the four sides is provided with an individual compartment for books, papers and writing materials, and the whole arrangement is one to encourage neatness.

The top, which is 3 ft. 6 in. square, is glued up solidly from 1⅜ in. oak or other hard wood. Use at least 4 dowels in each



Four handily arranged compartments for books and writing materials are provided

joint. The legs are shaped up from 2-in. square stock, 2 ft. 1⅝ in. long. If stock of this size is not available, the legs can be glued up from ⅞ or 1⅛ in. boards. The rails are ⅞ by 3 in., and the compartments are formed by slats ¼ or ⅜ in. thick and 2 in. wide, screwed to the rails and shelves.

The table top should be attached to the rails from underneath, either by means of regular table top fasteners or wooden blocks. A strip fastened to the under side of the table supports the slats at the back and inside end of each compartment. The braces, cut as shown, or in some other ornamental shape, are screwed in place beneath the lower shelves.

In finishing the table, the top should be scraped and the whole sandpapered carefully and then given a coat of filler and several coats of shellac or a good commercial varnish stain. Other methods of finishing that may be used, if preferred, are to shellac and wax it, stain and wax it, or give it the standard and most durable combination of stain, filler, shellac, and varnish.

Small Soldering Copper Holds Heat Better when Wire Wound

TO MAKE it possible to retain heat in a small soldering copper, soft wire may be wound around the square body and part of the shank. This will add considerably to the weight of the copper and it will not lose its heat so quickly.—R. G.

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Earaches	*Lumbago*	*Sprains*
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"Go North, Young Man!"

(*Continued from page 25*)

half of Alaska, and wheat near the Mackenzie, north of Great Slave Lake, truck gardening can hardly be said to pay when there is another much more profitable use to which the land can be put—that of raising meat. Just as in New York, the corner of Broad and Wall streets would make a neat little garden plot, but the owner finds he makes rather more out of it if he puts up a skyscraper and rents out offices. So with the North. You can produce beef there to much greater advantage than beans.

About 25 years ago the American government imported into Alaska about 1200 reindeer to stock a ranch. Today those reindeer have multiplied until there are now more than 200,000 of them, in spite of the fact that more than 100,000 have been butchered and the carcasses shipped south to cities where the meat has sold as a luxury. At present the reindeer industry in Alaska is a government monopoly, but Canada, with many times the grazing area, is open to the astute settler. It costs practically nothing to raise reindeer. With the aid of dogs one man can herd as many as 1500 animals, just as sheep are herded.

Ovibos Wool Does Not Shrink

Like the reindeer, the hairy, oxlike Ovibos (musk-ox) is a valuable native of the north country. We are experimenting now with Ovibos wool, and find that it makes excellent cloth, with the added advantage that the cloth does not shrink when wet. And where is there not a market for unshrinkable woolen goods?

But in other ways apart from industry you must fit yourself to Nature to be a successful settler in the Far North. First, you must provide against the cold of winter. You must abandon fashion for warmth. The sweater, which gives little real protection against the cold and blowing snow, must give way to furs. Your hands and feet must have serviceable coverings far removed from the orthodox gloves or leather shoes.

The settler must live in a different kind of house too. In the Mackenzie delta, along the shores of the Arctic Ocean, we built sod houses that gave perfect comfort. They are built with a framework of wood, and walled up with sods several inches thick, making them warm as toast in winter, and cool in the summer when the sun does not set for days. Of course, these houses are not very beautiful, but beauty won't help you very much when the thermometer drops below zero, or when it shoots above 90 in the shade, as it occasionally does in the summer.

Eskimos Imitate the White Man

In places like Herschel Island, where the white man has been for a long time, I found that the Eskimos, who formerly lived comfortably in tents, are now converted to the white man's frame house, because they think it is more "civilized" and fashionable. The Eskimos, a childlike people, are quick to follow a fad, however unfitted it may be to their needs. The result of this change of quarters is to give them habitations that are hard to heat, even when kept almost airtight (I even found the keyholes stopped up with chewing gum in the homes of some of the "best citizens" of the Eskimos), and that are unsanitary germ breeders.

(*Continued on page 101*)

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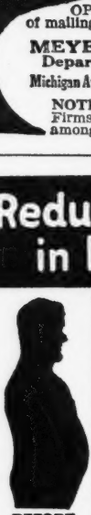
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Send your name, address and present waist measure. If no tape is handy cut a piece of string to the proper size and mail it to us. We will send you a "Wonder." Health Belt by return mail. At the end of five days if you are thoroughly delighted with the belt, remit $3.00 in *full* payment. If not, return the belt to us and you will not owe us a penny.

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HAVE the fun of doing it yourself and save half the cost. This book gives directions for making hundreds of electrical appliances and devices for the home, the shop and the garage. The simple directions and many drawings make the work easy.

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This is a real map—28 by 36 inches on bond paper, made to fold conveniently for the pocket. 6,000 name places. Latest U. S. Government Radio data. Usually priced at 50 cents. We'll mail one to you on receipt of 10 cents to cover postage and packing—if you'll send us your radio dealer's name. We're doing this because we want every radio enthusiast to know about Burgess "B" Batteries. Don't forget to send your dealer's name. Just address:

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"Go North, Young Man!"

(Continued from page 100)

To colonize in the Far North, you must get rid of a lot of false fears. When I first went to the Arctic, I was obsessed with a fear of the long winters. But in the years I have spent there I have learned that this fear was needless. We all enjoy sleighrides, toboganning, skating, house parties and smokers after dark in America. Why should the fact that we are north of the Arctic Circle take all the joy out of life?

The man who can rid his mind of some of these popular misconceptions can get along very comfortably and profitably in the north. It's an easy place to live in, a place where getting your food is sport. The climate is stimulating and bracing; you feel like doing four times the work you do in the States. Life is cut to essentials. Yet you can have many of the desirable things of civilization, plenty of open air, food, warm clothing, adventure, contact with strange but pleasant natives—the Eskimos, when you get to know them and their ways, are as charming friends as I have ever made. All these things are yours. And you don't have the crowds, the noise, the struggle to get money and outdo your neighbor, the dirt and disease of a great city.

Hidden Wealth of the Arctic

And the material advantages? Well, the North is destined to become the great meat-raising center of the world. The cost of raising reindeer is so small that shipping the meat south will net a yearly increasing profit. Oil has been struck at Fort Norman, and prosperous cities are bound to follow. Minneapolis grew up in a very similar climate. There is coal in the Parry Peninsula, in Melville Island, Lougheed Island and Banks Island. Also there is iron in many places. In Victoria Island and around Bathurst Inlet there is copper. It is easy to imagine Pittsburghs and Birminghams springing up close to the Arctic Circle some day.

Just now the chief resources are furs and fish; tomorrow it may be oil and minerals, and meat—above all, meat! The time will come when large tracts of grazing land in the United States will disappear and when we shall have to look elsewhere for our meat supply. The ranches of the West are growing fewer and fewer already. We need the ground for farms—to raise cotton and grapefruit in Texas, corn and hogs in Iowa, wheat in Minnesota and Manitoba and Saskatchewan, and apples in the northwest. The grazing must be done somewhere else, where vegetables, fruits, and cereals cannot profitably be raised. And that somewhere else is the rolling prairies of the polar shores.

The World's Meat Market

Economically, the Far North's greatest contributions to civilization will lie in solving the evergrowing food problem of the world. Reindeer, already a favorite meat in many parts of Europe, and served as a luxury in the clubs and hotels of a few great American cities, will find its way ultimately to every table in the land.

The rapidly increasing population of civilized centers must not only be fed, but must have room to spread out. In the North is plenty of room; three fourths of Canada and much of Alaska are awaiting settlement. Don't forget that, square mile for square mile, Canada is a larger land

(Continued on page 102)

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He who smokes last smokes best

Wherein our correspondent takes a long shot at Zanesville, O.

When we printed a letter from a smoker who professed a preference for the early morning smoke, apparently we started something. Almost the next mail brought along a batch of letters, among which the following is a fair sample:

Dear Sirs:
Will you allow me to take issue with your A. K. K. from Zanesville, who insists that the best pipe of the day is the one smoked right after breakfast?
Of course, I have no intimate knowledge of local conditions down in Southern Ohio, but up here the majority of us regular pipe smokers have a decided leaning towards the last pipe of the evening.
Take a night when you are sitting in front of the fire after the neighbors have gone. Your wife suggests it is bedtime, and while you admit it is, you have a craving for one last smoke. She goes on upstairs and you promise to follow directly. But instead you take out your pipe and light up. You smoke slowly and peacefully, calling out at intervals that you'll be there in a minute. Only you don't go until the last ash has died in the bowl of your pipe.
That's my idea of the best smoke of the day.
Yes, sir, for every smoker A. K. K. can produce who likes his after-breakfast pipe best, I'll guarantee to name a dozen men who prefer the last smoke of the evening. And most of us are Edgeworth smokers, too.
Yours very sincerely,
(Signed) T. S. Flint,
New York City.

Yes, as we suggested above, when we gave space to an expression of opinion about which is the best pipe of the day, we started something. But we are glad to open our columns to friendly discussions about pipes and smoking in general.

So if you have any particular notions, fads or fancies, send them along. We are taking a neutral standpoint ourselves, not even acting as referees in the debate.

And if you aren't an Edgeworth smoker, be sure and tell us about it. For we want to send you free samples, generous helpings both of Edgeworth Plug Slice and Ready-Rubbed.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome tin humidors, and also in various handy in-between sizes.

For the free samples address Larus & Brother Company, 59 South 21st Street, Richmond, Va. If you will also add the name of the dealer to whom you will go if you should like Edgeworth, we would appreciate that courtesy on your part.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

"Go North, Young Man"

(*Continued from page 101*)

than the United States. If you should drop Texas, the largest state in the Union, into northern Canada, you could hardly find it. The distance from Nome to Sitka, Alaska, is as great as the distance from New York to Omaha. So there's plainly plenty of room to move about in.

Finally, certain important political results are sure to follow colonization of the North. When Canada is settled from south to north as it has been from east to west, it will run the United States a close second in wealth and population.

The North will reward the pioneer, in cash and spirit, fully as richly as have the great plains of our own "Wild West."

Will There Be a $150 Car?

(*Continued from page 91*)

worn out, simply because the wear is confined to moving parts. It would be desirable to design the $150 car so that it would run for four years without extensive overhauling. At the end of that time it could be sold back to the manufacturer at the rate of two cents a pound, or $20. Thus, expensive adjustments could be ignored during the life of the car.

When a car is worn out, there are many important as well as minor units that are invariably as good as new, such as the crankcase, flywheel, transmission case, connecting rods, pedals and levers, propeller shafts, drive shafts, steering wheel spider and steering linkage. Whenever an owner should sell his car back, it would be forwarded to the assembly depot. Those parts that passed inspection would be used again, while the worn parts would still be worth their cost as scrap metal. The scrap would then be sorted into cast iron and steel, broken up and melted—a process far less wasteful than the present methods of junking.

In cities it would be feasible to build public garages especially designed for these small machines at a cost approximately one fourth that of the average present day garage building.

These are more than possibilities—and if Durant, Ford, and other geniuses of the automobile world know what they are talking about, the $150 car will be with us within the time that it took Ford to reduce the price of his car from $1000 to about one fourth that amount.

Camera Contest Prizes

AWARDING of prizes this month in POPULAR SCIENCE MONTHLY'S $500 prize camera contest marks the close of an interesting 10-month competition in which $50 in cash prizes was awarded each month for the three best photographs of subjects of scientific and mechanical interest. The prize-winners for January are:

FIRST PRIZE, $25—**C. M. Vaiden**, San Diego, Calif. Subject: "Thrilling Race with Flood Saves Cost of Dam" (see page 43).

SECOND PRIZE, $15—**C.W. Seitz**, Hillsdale, Mich. Subject: "Harnessed Mud Turtles Clean Clogged Drains in Michigan Town" (see page 46).

THIRD PRIZE, $10—**A. K. Chenowith**, London, Ohio. Subject: "Mechanical Harvest Hand for Hay Wagon" (see page 54).

Genuine Diamonds On Credit for Xmas

SWEET Diamonds are all specially selected gems of superior quality. All absolutely perfect in cut, and blue-white in color. Guarantee Value Bond given with every Diamond certifying to the high quality of the stone and allowing for a 7½% yearly increase exchange value.

M1 — SWEET Engagement Ring of 14K Solid Gold, set with a perfectly cut, blue-white Diamond. **Price $50**

M2 — 7-Diamond Solitaire Cluster set in Platinum, resembles 2½ ct. single stone. **Price $48.50**

M3 — Perfectly cut blue-white Diamond set in SWEET Engagement Ring of 14K Solid Gold. **Price $35**

M4—The "Daphne" of Solid Platinum with a perfectly cut Diamond box-set in hand-engraved mounting. **Price $65**

M5—Artistic design of Platinum, its beauty enhanced by five exquisite blue-white Diamonds. **Price $135**

M6 — SWEET'S Cupid Solitaire of Solid Platinum, set with a perfectly cut, blue-white Diamond. **Price $100**

M7—The Trojan of 14K Solid Green Gold, elaborated by a 7-Diamond Solitaire Cluster, set in Platinum. **Price $90**

M8 — Gentlemen's massive, hand-carved and engraved Ring of 14K Solid Green Gold, set with a perfectly cut, blue-white Diamond in White Gold. **Price $85**

M9—Ladies' fine, 15-Jewel Wrist Watch with Sapphire Jewel Stem and beautifully hand-engraved case of **14K Solid White Gold.** Guaranteed against repairs for one year. **Price $21.00**

We'll send any of these beautiful articles **Absolutely Free** for your complete examination and approval. If thoroughly satisfied, pay only one-fifth the price, then send the balance in ten equal monthly payments. If not satisfied, return it and every penny will be immediately returned. You must be satisfied, or no sale. Transactions strictly confidential.

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Atkins Hack Saw Blades cut faster, run easier, hold their edge longer and are practically non-breakable — save time, labor and money on every metal-cutting job. Made of selected steel, they are hardened and tempered by a special gas and oil process which gives them a hard, keen edge and a tough, flexible back.

Prove for yourself that an Atkins Hack Saw Blade will out-cut and out-last other blades. Send us ten cents for sample 8 or 10 inch blade, and tell us what metal you wish to cut.

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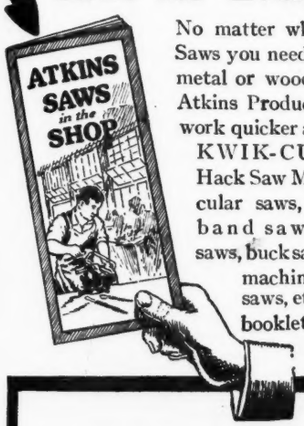

No matter what kind of Saws you need for cutting metal or wood, there's an Atkins Product to do the work quicker and better—KWIK-CUT Power Hack Saw Machines, circular saws, hand saws, band saws, cross-cut saws, buck saws, drag saw machines, pruning saws, etc. Write for booklets on any saw you need.

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Jack Binns' Radio Rules

(*Continued from page 71*)

and honeycomb coil mountings where two coils can either be moved apart from each other or turned around at various angles to each other. The operation of these two instruments easily explains the method of varying the inductive relationship between two coils.

7. Remember the Tickler Is Married to the Tuner.

One of the most puzzling questions to the average radio fan is the correct ratio of turns in the tickler to those in the tuning coil. As a general principle, you cannot go wrong if you adopt a ratio of 1½ to one in favor of the tickler coil where the latter is of fixed value and its variation is made by changing its angle in respect to the tuning coil. This means that if the tuner has 50 turns, the tickler should have 75.

Where the tickler is stationary in relation to the tuning coil, the tickler should be tapped in the same manner as is the tuning coil. These taps should be joined to contact studs in the usual manner and then the regenerative effect can be controlled by varying the number of turns in the feedback circuit. The tube can be prevented from oscillating by reducing the amount of current flowing through the filament.

If you are building your own regenerative set and are in doubt about the exact ratio, remember that an ordinary short wave variometer makes an excellent tickler coil. All that is necessary is to connect it with the plate circuit of the vacuum tube detector and then place it alongside the tuning coil.

If there should be no regenerative action from the variometer, its connections should be reversed. The amount of regeneration in this case can be adjusted by varying the rotor of the variometer.

8. Learn the Function of Condensers.

There are two terms used in connection with a condenser that my correspondents find perplexing—"bridging condenser" and "bypass condenser." Both terms apply to one and the same instrument. It is no different from any other condenser, and is simply put into the circuit to permit high frequency currents to pass easily by what would otherwise be an obstacle.

To explain: Consider the telephones. The windings around the coils inside telephones offer high resistance, or impedance, to high frequency currents. If a condenser is placed across the telephones, the impedance is immediately reduced to a minimum and the higher the frequency of the current, the easier it will pass through the condenser.

We can understand this function better if we consider the action of a condenser. We know that it consists of two sets of plates separated by an air space or other dielectric. Now, at the instant a direct current is applied to the condenser, there will be a short passage of current. But when the condenser is charged to its maximum, there will be no further current flow. If we reverse the current, there will be momentary current flow in the opposite direction.

If we use alternating current, this charging and discharging will occur at a rate corresponding to the frequency of the current used. At the moments when the current is at zero, there will be no passage through the condenser. It will be seen, therefore, that the more rapidly the current

(*Continued on page 104*)

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IN a dirty, forlorn shack by the river's edge they found the mutilated body of Genevieve Martin. Her pretty face was swollen and distorted. Marks on the slender throat showed that she had been brutally choked to death. Who had committed this ghastly crime? No one had seen the girl and her assailant enter the cottage, no one had seen the murderer depart. How could he be brought to justice?

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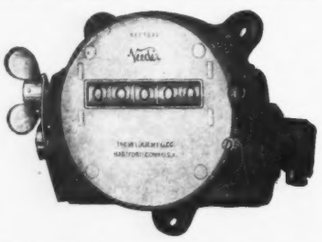
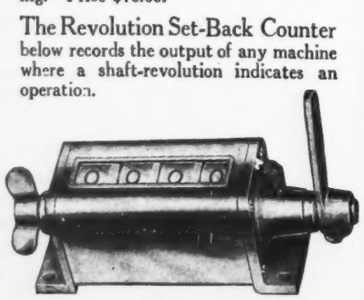
Veeder COUNTER

Here's a big new development in a Punch Press Counter; a heavy-cased ratchet mechanism, immensely durable:



Built especially for recording the product of punch presses, metal stamping machines and other heavy-duty machinery. Strong stops limit the movement of the lever to 45 degrees or ⅛ turn, which registers one on the dial. The large, legible figures are easily read ten feet away. Counter is regularly furnished with five-figure wheels, and may be *set back to zero* by one turn of knob. Requires no special fixtures for attaching. Price $18.00.

The Revolution Set-Back Counter below records the output of any machine where a shaft-revolution indicates an operation.



Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list).

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The Veeder Mfg. Co.,
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Jack Binns' Radio Rules

(*Continued from page 103*)

is alternating, the more readily it will pass through the condenser. Since broadcasting by radio is usually done on 360-meter waves and the frequency with which the current alternates is 833,333 cycles a second, it will be seen that the condenser plays an important part as a bypath of low impedance for these currents.

9. Treat Your Neighbor as You, Yourself Would Be Treated.

Remember that your regenerative receiver under certain conditions is a weak transmitter of radio waves, especially if it is of a single circuit type. It radiates energy just the same as the broadcasting station. The moment you turn your filament on full, producing the heterodyne effect already explained, you are transmitting a carrier wave that will seriously interfere with other neighboring receiving sets. If your set is not correctly adjusted to the same wave length as the broadcasting station, your wave will heterodyne upon the wave sent out by the latter and the clash will be recorded on every other receiver within several blocks. This means that the enjoyment of your neighbors will be seriously interfered with. Therefore don't turn your set into a transmitter.

10. Learn to Use the Triple Tuned Regenerative Receiver.

Many fans ask me how it is that the variocoupler-two-variometer type of receiver gives regeneration when there is no inductive relationship between the plate circuit and the tuning circuit. Remember that there are two ways of obtaining regeneration, first by means of an inductive coupling, where two coils are placed in an inductive relationship, and second by means of a capacitative coupling where the coupling element is a condenser. The simplest regenerative connection of all is a condenser joined to the grid and plate terminals of the vacuum tube. This, however, is not entirely efficient.

To a certain extent the variocoupler-two-variometer circuit is capacitatively coupled in that it utilizes the internal capacity of the vacuum tube itself in conjunction with the inductances in the grid and plate circuits. These inductances are, of course, the two variometers. The regeneration occurs when both are tuned in exact resonance with the frequency of the incoming signal.

The variocoupler-two-variometer type of receiver is the most efficient in eliminating interference, but of course it is a little more difficult for the average novice to adjust.

Gasoline Used to Draw Tracings

ROUGH pencil tracings of drawings, maps, and diagrams can be made on opaque paper without the aid of carbon paper or other transfer mediums if a little gasoline or benzine is available.

Tack the paper over the original drawing and pour some gasoline on it from a safety container or small bottle. This will render the paper sufficiently transparent to make the drawing below visible through it.

You will find that the gasoline quickly evaporates, so that you must trace rapidly or wet the paper over again with gasoline. It is advisable to trace only a small area at a time. When evaporated, the gasoline leaves no trace and in no way injures either drawing.—C. NYE.

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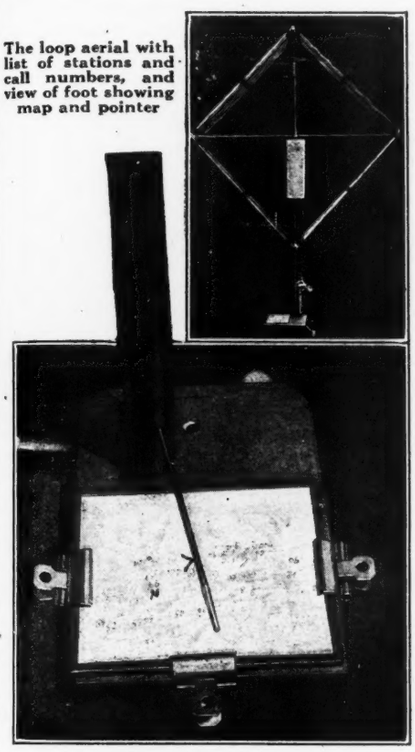
THE HOME WORKSHOP

Direction Finder and Map Aid in Use of Loop Aerial

SINCE loop aerials must be turned in the direction of the radio broadcasting station that it is desired to tune in, a direction finder and broadcasting map similar to the one illustrated is a useful addition to the radio fan's equipment.

A small platform is attached to the base of the loop aerial stand and upon it is mounted a broadcasting map correctly oriented. A pointer fixed to the revolving standard of the loop aerial just above the



The loop aerial with list of stations and call numbers, and view of foot showing map and pointer

map is set by means of a pocket compass and used as a guide in turning the coil in the direction of the sending station. In some cases it is necessary to have the map arranged so that the shaft is in the center; this is when there are transmitting stations on all sides of the loop.

In the pictured installation the sending stations are identified by numbers on the map and corresponding numbers on a list of stations, call numbers, and other data fastened to a clip board that is mounted higher up on the loop standard.—JOHN A. MAHON, Baltimore, Md.

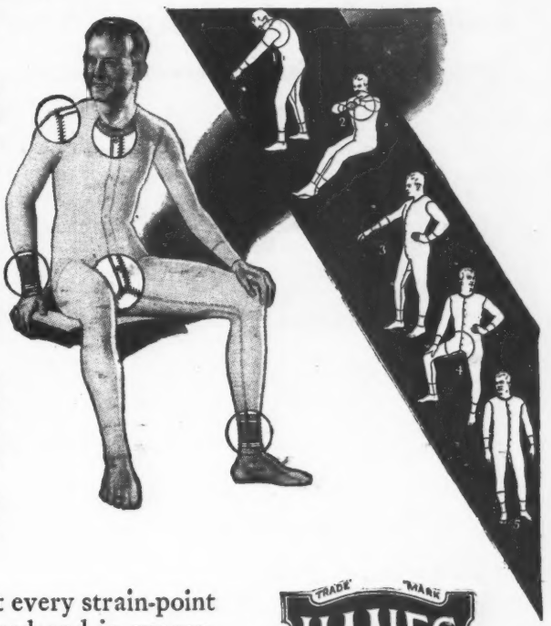
Old Bicycle Inner Tube Renews Life of Typewriter Roller

WHEN I discovered that the rubber roller on my typewriter was so hard that the heads of the type bars were in danger of being broken off through striking the unyielding surface, I cast about for a way to provide a softer platen without the necessity of sending the machine to the factory for repairs.

I bought an old inner tube at a bicycle repair shop for 25 cents, cut off a piece 12 in. long, turned it inside out, pulled it over the roller and cut off the ends. The tube needs to be slightly smaller than the roller so that it will be stretched a trifle when in place. This repair has given entire satisfaction.—G. D. SHAFT, Minot, N. D.

5 Big Reasons why you'll like HANES

Read these over one by one. You'll be amazed to find such features in popular-priced underwear.



1 **Hanes Staunch Elastic Shoulders** are made with service-doubling lap seam. They fit right, with plenty of "give" for every motion.

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4 **Hanes Closed Crotch** is cut and stitched in a special way that really keeps it closed.

5 **Hanes Elastic Ankles** hold their shape through repeated washing. They never bunch over your shoes, but fit always.

THEN consider that every strain-point is strongly reinforced and is guaranteed to hold fast. That the flat, non-irritating seams are guaranteed not to break. That the fine quality buttons are guaranteed to stay put. That the buttonholes are guaranteed to keep their shape.

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Bear in mind, too, that Hanes Winter Underwear is made of fine, fleecy cotton that keeps out cold. It's cut and tailored to fit. It snugs close, but without the slightest pulling or binding.

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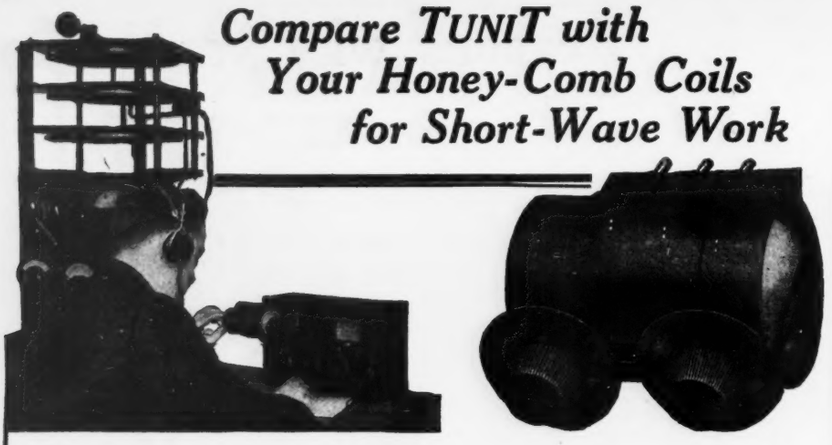

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THE HOME WORKSHOP

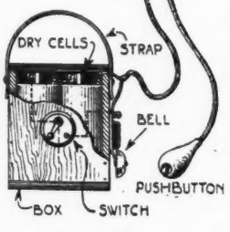
Every Room in the House Wired for Radio and Call Bell

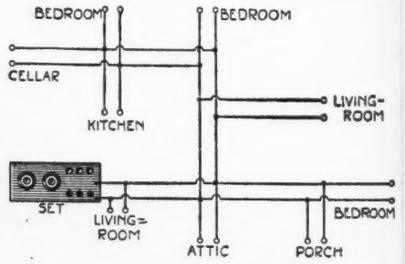
By L. C. Porter

THE pleasure and educational benefit from broadcasted radio programs so appealed to me that I had every room in my house wired for radio. Later the same wiring was utilized for an emergency call system from one room to another.

If my family chooses to sit on the front porch, the music is with us. If we are washing dishes in the kitchen, there, too, we may have music, lectures, sporting results, and the like. It takes but a few seconds to change the phone from one room to another.

Contrary to the general impression, a loudspeaker does not have to be located at or close to the radio receiving set. It may be placed at almost any desired distance from the set and connected with it by means of ordinary bell wire. Neither is it necessary to have a large or expensive horn. A cone of stiff brown paper rolled up so that it is about 6 in. long, 4 in. in diameter at the mouth, and ½ in. in diameter at the throat, will give satisfactory results. A 25-cent megaphone, such as is used at football games, with a type C Baldwin phone taped to the end, makes a good loudspeaker.





Wiring diagram and the box used in connection with call bell system

I ran a pair of No. 18 bell wires from my radio set to every room in my house, as well as the attic, the cellar workshop, and the front porch. These wires terminated in each room in a pair of binding posts set into a small block of wood nailed to the trim. Over each pair of binding posts a cup hook was screwed into the wall about 7 ft. above the floor to hold the loudspeaker and horn out of the way. The receiver was placed permanently in the living room, connected by leads through the floor with the storage battery in the cellar. A single point switch was arranged for disconnecting the radio instrument, when desired.

The same wiring is used as a call system. Two standard dry cells are kept in a wooden box with a doorbell and a small switch on the outside. About 4 ft. of ordinary lamp cord are connected with these. A pushbutton is attached to one end of another 4-ft cord. Therefore, if the bell is attached to any pair of binding posts, and the pushbutton to any other set, pushing the button will ring the bell. This is a great convenience in case of illness, because the pushbutton can be placed beside the patient's bed and the bell in the kitchen.

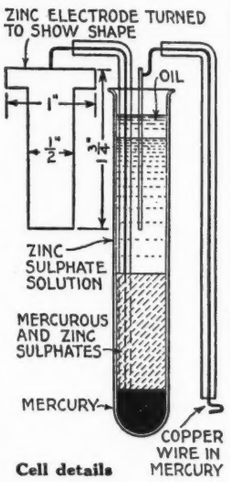
THE HOME WORKSHOP

Homemade B Battery Reduces Noises of Detector Tube

By C. H. Ward

FROM the number of different makes and types of radio B batteries sold, it is evident that the last word on plate voltage supply has not been said and probably will not be until a satisfactory device is perfected for the direct use of 110 a.c.

For detector operation I stumbled upon what appears to be perfection in homemade batteries. Its cost is higher than a dry cell, but it is rechargeable and its very steady voltage and freedom from noise will justify the greater investment. Chemically, it is a copy of the Clark standard cell, hence its steady voltage. This is a little over 1.5 (1.43 in the standard cell, which uses zinc amalgam), so that 15 cells give ample voltage for detector operation.



Cell details

The cells are contained in 4-in. test tubes about ½ in. in diameter, mounted in a rack. In the bottom of each tube is placed a ½-in. layer of mercury for the positive pole, into which dips the connecting wire from the next cell as shown. On the mercury is placed a layer of depolarizing paste about 1½ in. thick. This consists of zinc and mercurous sulphates finely ground together in the presence of a few drops of mercury. The powder is moistened with a saturated solution of zinc sulphate, and enough of this solution added nearly to fill the tube. Evaporation and creeping is prevented by a shallow layer of oil.

Runs Year without Recharging

The negative pole consists of a T-shaped piece of sheet zinc, the arms of which rest on the top of the tube. A piece of copper wire is soldered to the zinc at the top and passes down through a thin glass tube into the mercury of the next cell. Rubber-covered wire may be used instead, provided the insulation is free from cracks.

This battery will last in moderate use for more than a year without recharging, and does not appreciably deteriorate. When it ceases to give service, it may be charged from any source of direct current at about ¼ amp. until the line of separation between the mercury layer and the depolarizer becomes once more distinct and the depolarizer is changed from a grayish color to white. This will take about 24 hours. As soon as the charge is finished, the zincs should be removed and replaced with new ones, as the zinc deposited during the charge is in a spongy state and upon discharge will drop off and foul the cell.

The size and details can be altered, but the relative proportions should not be greatly changed. In any case, it is important that no part of the copper connecting wire come in contact with the electrolyte so as to permit current to flow from it to the zinc during charging.

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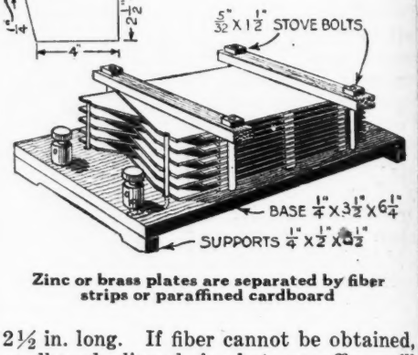
THE HOME WORKSHOP

Air Gap Telephone Condenser Improves Radio Reception

By Loyd B. Gangawere

BECAUSE of its efficiency, this condenser, while more bulky than the ordinary phone condenser, is well worth constructing. The writer has tried it on several sets and it has always brought in clearer signals than the ordinary tinfoil and paraffin paper type.

Either 9 or 11 plates of zinc or sheet brass are cut as shown and 27 or 33 separators made of 1/32-in. sheet fiber ¼ in. wide and



Zinc or brass plates are separated by fiber strips or paraffined cardboard

2½ in. long. If fiber cannot be obtained, cardboard dipped in hot paraffin will serve.

Two end separators are placed on the base, the first plate is laid on them, and two more end separators and the second plate are put down. This is continued until all the plates are stacked. It does not matter whether the separators are in exactly the right position during the stacking operation.

The wooden clamps, 5/16 by ½ by 3½ in., are next placed in position and the bolts drawn up loosely. The plates are then pushed into place and the separators put in position with a table knife or old hacksaw blade. The stove bolts are tightened and the center separators placed in position with the aid of a knife or saw blade. A piece of wire is soldered to the ends of each series of plates and taken to binding posts.

The condenser may, of course, be fastened directly to the back of a panel, instead of being mounted on a base.

Storm Sash in Two Sections Opens for Ventilation

TO OBVIATE the difficulty of ventilating a room, the windows of which are closed by storm sash, an ingenious householder uses a homemade two-piece storm sash that is hinged at the center. This arrangement permits lowering the top or raising the bottom section of the sash, as illustrated, whenever it is desirable to air the room.

The two sections of the combination sash are held in place by hooks and eyes. The edges of the sash are covered with strips of felt so as to form as nearly an airtight joint as possible against the window frame.—G. H. DACY.

THE HOME WORKSHOP

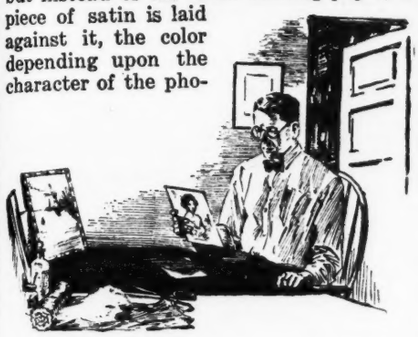
Photographic Transparencies Give Artistic Color Effects

By Herbert C. McKay

BEAUTIFUL colored photographic transparencies known as Doré-types can be made very easily by the amateur photographer.

From a selected negative a positive transparency is made on a slow plate. This should be full of detail but very thin. After development and fixing, it is redeveloped by the ordinary sulphid method to a warm sepia. This is tinted or not, as demanded by the subject in hand.

The positive is then placed in a frame, but instead of the usual backing paper, a piece of satin is laid against it, the color depending upon the character of the pho-



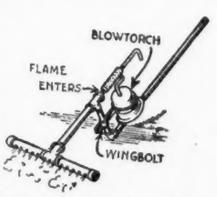
tograph. A very light rose is best for portraits. Never use white, as it deadens the lifelike effect that is the principal characteristic of the Doré-type. Green is good for landscapes, while a delicate blue is suitable for marines or moonlight effects.

Upon the satin is laid a comparatively thick layer of cotton to prevent any wrinkle or sag. Some operators cement the satin to the positive with white shellac, but this requires the utmost care. The backing board is then fixed in place and the Doré-type is complete.

Gasoline Torch "Flame Thrower" Removes Ice from Walks

NO MATTER how assiduously one may ply the snow shovel, the danger of icy sidewalks to pedestrians is difficult to prevent without sprinkling salt or ashes over the surface. The flame thrower illustrated will, however, enable any storekeeper, shop-owner, or householder to remove the ice from his walks in a short time.

Several lengths of 1-in. gas pipe, two tees, one elbow, two caps, and a piece of strap iron are required. The gaspipe is cut into two 6-in. lengths, two 12-in. lengths, and one 3-ft. length. The parts are then assembled, the strap iron forming a detachable band for holding the blowtorch. The torch is clamped by means of a wingbolt in such a position that the flame enters the pipe, as indicated.



Gasoline torch supplies the heat

When the device is pushed over the walk, the heat coming from the perforations quickly melts the crust of ice and dries the walk. Care should be taken not to allow the pipe to remain in one place long enough to check or crack the cement.—G. E. HENDRICKSON, Argyle, Wis.

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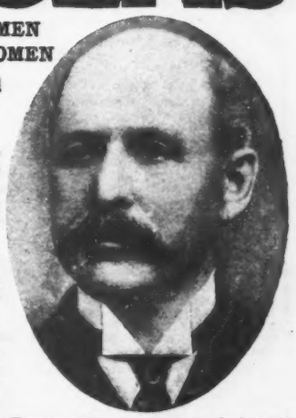

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THE HOME WORKSHOP

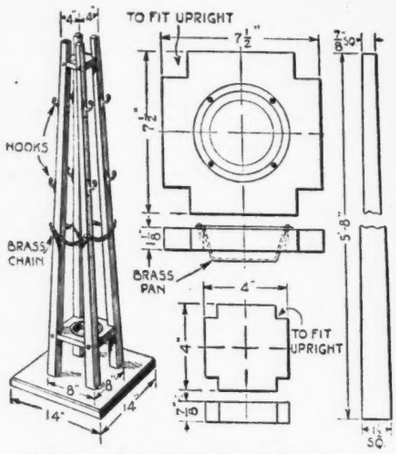
Hatrack and Umbrella Stand Easily Constructed

THIS simple hatrack and umbrella stand is designed along novel lines and can be put together with a minimum amount of work.

The materials needed are:

Four hardwood strips 5 ft. 8 in. long, tapering from ⅞ in. at one end to 1½ in. at the other
One block of hard wood ⅞ in. thick and 4 in. square
One block of hard wood 1¼ in. thick, 14 in. square
One block of 1½-in. wood 7½ in. square
One brass drip pan 4 in. in diameter, or square
One brass chain
Eight brass coat hooks
Eight brass round head screws 2½ in. long
Four flat head iron screws 3½ in. long

The base is finished off and the upper edges are beveled. The uprights are then spaced as shown and mortised into the base for about ⅝ in., glued and screwed from



The stand assembled and its parts

beneath with the iron screws. The blocks are mortised between the uprights and secured by the brass screws, as indicated. The hooks can be set at any desired heights.

Any available hard wood may be used and painted or varnished to conform to the finish of the woodwork in the hall or room where the rack is to stand. Feet in the form of a cross may be substituted for the baseboard, if preferred, and other variation in design made to relieve the severity of the straight lines.—D. R. V. H.

Bench Stop with Beveled Slide Holds Work Rigidly

THE wooden bench stop I am using is one that can be made in a few minutes from any scrap of 1 or 2 in. material. It will be noted that the slide or wedge is

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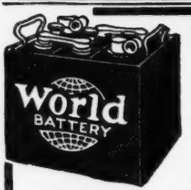

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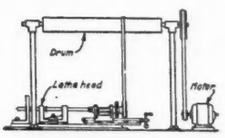
(*Continued from page 78*)

being checked for accuracy before assembling. They are held apart by ½ by ⅝ by 3 in. pieces and ⅜-in. flathead screws hold the assembly together. While the lower plate needs only to be flat, the top plate must be flat and straight as well. This should be checked with a micrometer and straight edge. Drill the holes for the ⅜-in. screws only 7/16 in. deep, so that they will not go through the top surface. In the lower plate are drilled 9/16-in. holes spaced 3 in. apart on the center line of the plate for the ½-in. bolts that clamp it firmly to the work plate.

A ½-in. 20-thread feed screw is mounted between brass bearings that are screwed to the top plate. This feed screw is fitted with a ball crank handle. The nut is also of brass and is riveted to one of the angle pieces that hold the head down on the shear plate.

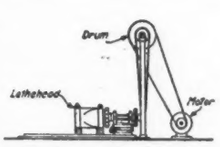


Boring spindle holes in lathe head with worktable parallel to workbench

The head itself is made of cast iron over a simple pattern that any mechanic can make. The pattern splits in two on the vertical center line, shown in the end view of the head detail. The casting is machined flat on its bottom surface, which is squared to exactly 4 in. The 1¼-in. spindle bushing holes, as well as the back shaft holes, are 2 in. above the base and absolutely parallel with it and the sides.

The bushings are turned from bronze and split, as shown, one cut going through and the other two stopping within 1/16 in. of the inside bore. This arrangement, together with the split head bearing, makes it easy to take up the bearings for wear or adjustment. Thrust on the spindle is taken up by ample surfaces of the thrust collar on the spindle, which rides against the bushing.

The spindle is turned from machine steel and has a No. 2 Morse taper. It is threaded on the nose end with 12 U.S.S. threads an inch. The drive gear is mounted on the spindle over a ¼-in. feather key and is held by the two lock collars. To the rear of the spindle is the back shaft, upon which run the drive pinion and pulley. The back shaft is held in place by two ¼-in. setscrews. In a drive reduction of from 1 to 3, a 12-pitch, 15-tooth pinion meshes with a 45-tooth gear. A detail of the pinion is included in the working drawing drawn to a scale twice as large as the rest of the details. The various easily obtainable gear ratios are given in the gear table.



Facing end of lathe with slab miller, the worktable being set crosswise

Care should be exercised to preserve all the dimensions as shown, particularly the center to center distance of the two shafts. For heavy cuts use the 1 to 3 ratio; for medium, the 1 to 2 ratio, and for light cuts, the 1 to 1 ratio. When high speed is desired, as for drilling with small drills, or

(*Continued on page 112*)

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THE HOME WORKSHOP

"Universal" Machine Gives Wide Range of Service

(*Continued from page 111*)

polishing work held in the chuck, use a 2 to 1 ratio by mounting a 20-tooth gear on the main spindle, and a 40-tooth gear on the back shaft.

A ¾-in. wide belt drives the pulley from the countershaft overhead. The drum is made by mounting a section of galvanized iron pipe 3 in. in diameter on two wooden disks that are keyed to the shaft. It is necessary to cut down the speed of the motor, and the proper speed of the drum will vary with the metals on which the operator happens to be working. The two best speeds for the drum are 30 and 75 r.p.m. These are obtained with suitable pulley combinations on the motor and countershafts. Sufficient power for driving the inserted cutter milling head shown is obtainable with the 1 to 3 gear ratio.

When the machine is used for drilling, boring, spot facing, counterboring, reaming, turning, polishing, and the like, the head is mounted parallel with the slide and is moved in and out on the slide with the feed screw mounted on the right side of the slide. A longitudinal travel of 8 in. is obtainable and deep holes can be drilled or bored.

Adjusting the "Universal" for Milling

When the machine is to be used for milling, the side angle plates are unscrewed and the head is turned 90 degrees and again screwed up with the angle pieces. The head then lies across the shears and is ready to slab mill or face the flat surfaces of machine parts. Woodruff key cutters and large end mills are held in a scroll chuck.

The inserted cutter head is used only for wide surface work. This head is threaded to fit the spindle and is fitted with 5/16-in. square steel bits held by hollow head setscrews. The cutters must be sharpened alike so that each will do its share of the cutting. A 3 15/16-in. faceplate is a useful attachment, as well as a scroll chuck with reversible jaws.

When turning or boring work held in the chuck, the tool is clamped on an iron or steel block in the position desired and the work is fed into the tool. By blocking up the work to the necessary height, the need of a vertical movement of the head is eliminated. When a job is to be handled that is too high, the slide is set up on parallels to suit. Fly cutters held in short bars in the chuck make possible difficult milling operations, and many other arrangements of tools and set-ups will suggest themselves to the builder and user of this machine. With it as a starter the ingenious mechanic can build his own lathe and other small machine tools.

Why Not Build a Cabinet for Your Radio Set?

IF YOU have a radio set, you should not miss an article on building radio cabinets in the Home Workshop Department next month. It will give a number of designs for homemade cabinets ranging from a simple stand to a magnificent large case with inlays and panels of burl walnut veneer.

THE HOME WORKSHOP

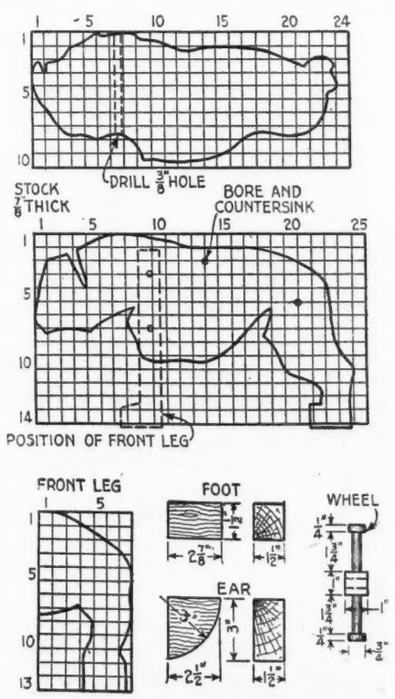
Little Tots Have Endless Fun Playing with Dogmobile

HAVING built this novelty dog for my boy, I thought that other fathers might like to make similar toys for their children.

The first step is to lay out and cut full size patterns from cardboard. This can best be done by taking one piece of cardboard 10 by 24 in., another 14 by 24 in., and a third 7 by 13 in., and dividing them up into one inch squares. On the first lay out a pattern for the central body piece, which has the dog's tongue at one end and the tail at the other. This is the top pattern shown below. The dotted lines represent the hole for the steering shaft. Use the second piece of cardboard for drawing the pattern of the body proper and hind leg. Two wooden pieces will have to be cut from this pattern. On the third piece of cardboard lay out the front leg and cut two of them. Use ⅞ in. pine, cypress, or other soft wood. The cutting can be done with a coping-saw, keyhole saw, fretsaw or band saw. Finish the edges with a file and sandpaper.

Riding the bulldog

It will also be necessary to cut two ears as shown, and two feet, 1½ by 2⅞ in., beveled a little on top, to be fastened on



A pattern for the main body pieces can be laid out on paper or cardboard divided into 1-in. squares

the front leg, as will be seen in the top illustration.

Through the central body piece drill a 7/16-in. hole for the steering shaft, counter-

(*Continued on page 114*)

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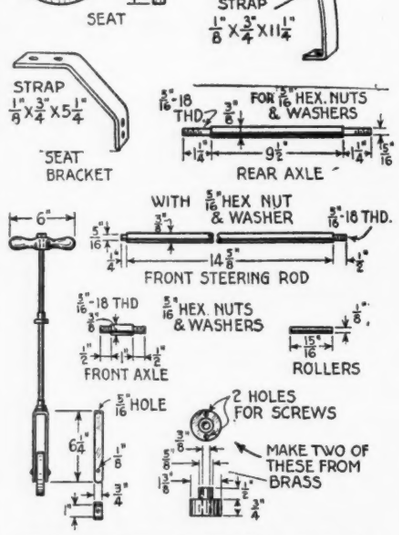
THE HOME WORKSHOP

Children Enjoy Dogmobile

(*Continued from page 113*)

sinking it at the top and bottom for brass bearings. On the inside of the front legs bore ¼-in. holes and insert pieces of ¼-in. round steel to serve as footrests. Screw the legs to the outside body pieces from the inside with flat head wood screws. Then screw the two outside body pieces to the central piece. Fasten the seat, ears, and feet in place with glue and screws, covering the screw heads with putty.

Any convenient method of arranging the wheels and steering apparatus may be used. The wheels are of steel and ten pieces of



Details of the seat, brackets, rear axle, front steering rod, front axle, rollers, and bearings

⅛-in. steel rollers form roller bearings, a washer on each side of the wheel holding the rollers in place. Wooden wheels can be used, if more conveniently obtainable.

After the dog is assembled, give the body two coats of flat white and one of enamel, and then paint the head, tail, seat, and middle parts black. Give the dog's tongue a coat of red paint.—EDWIN W. HOSEUS, Cincinnati, O.

How to Restore Burned and Worn Soldering Irons

SOLDERING coppers, commonly called "irons," after being used a number of times, finally get into such a condition as to require filing into shape. The effects of frequent heating and cooling and the occasional burning off of the tin coating through overheating produce a sort of case-hardening that prevents even a new file from having much effect.

After putting up with this for some time, the writer tried an old horseshoer's rasp, which has large rounded teeth. These cut right into the hard surface, but left it too rough for the tinning process. All the roughness, however, was easily filed smooth with an ordinary file, which was kept well oiled, and cleaned frequently with a file-card.—W. S. STANDIFORD, Youngstown, O.

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How to Build Humidifiers

(*Continued from page 70*)

tray is 1½ in. deep and extends flush with the ends in front, or about ⅛ in. farther than the trays above.

The galvanized iron used in constructing the device may be any thickness from 24 to 30 gage.

Water is poured into the top tray and it cascades down until all the shallow trays are filled, any excess running into the large tray at the bottom.

The air rises behind the lower tray to the space in back of the bank of trays. Since it cannot escape directly through the top because of the top piece, which in this case is 9 by 22 in., the air passes over the trays and is moistened by the water in them.

Trough and Wick Type

The second type makes use of cloths suspended between the upper and lower troughs in such a way that they are kept moist by capillarity. The upper troughs are ¼ in. wide and have one side ⅞ in. high and the other ¾ in. high. These are soldered in position between a front piece and a somewhat larger filling trough ⅞ by ⅞ in., which runs across the back. Holes are punched to allow the water to flow from this cross trough into the smaller ones.

The lower system of troughs is exactly the same except that each small trough is centered under the ¾-in. edge of the corresponding trough above. This is made clear in the illustration.

The upper and lower troughs are connected by means of cloths, which are hemmed at the top and bottom and have galvanized iron rods in the hems to hold cloths taut. Old bed sheets were found by Dr. E. P. Lyon, the designer, to be excellent for this purpose, whereas cheesecloth did not work as well. The width of the cloths should be from 10 to 15 in.; anything in excess seems to reduce the efficiency of the apparatus because the cooling effect of evaporation interferes with the air currents.

Providing Water Supply

This kind of humidifier can be filled by hand and the excess from the lower cross trough drawn off through a rubber tube into a large bottle or pail on the floor. Less attention is required if an inverted bottle is arranged, as in a poultry drinking fountain, to keep a constant level of water in the upper trough.

To simplify further the work of attending to the humidifier, it is well to provide a small pipe from the house water supply or from a tank to the upper supply trough with a valve to cut down the flow of water to the requisite amount. The excess can then be carried off by another pipe to a sink or the house drain. Very small pipe will serve for this purpose; even copper tubing used for automobile gas and oil lines. All that is necessary for humidifiers on the first floor of a house is to bore two holes for the pipes through the flooring, back of the radiator.

The simplest method of finishing the humidifier is to gild or cover it with paper to match the wall. A light wooden frame with grillwork along the lines of the door in a phonograph sound chamber can be constructed, if care is taken not to impede the circulation of air to any considerable extent.

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Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., for October 1, 1922. State of New York, County of New York, ss. Before me, a notary public, in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Modern Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Editor, Kenneth W. Payne, 225 West Thirty-ninth Street, New York, N. Y. Managing Editor, Paul A. Jenkins, 225 West Thirty-ninth Street, New York, N. Y. Business Manager, O. B. Capen, 225 West Thirty-ninth Street, New York, N. Y. 2. That the owners are: The Popular Science Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 225 West Thirty-ninth Street, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; George B. Agnew, 22 William Street, New York, N. Y.; Susan D. Bliss, 22 William Street, New York, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: O. J. Ridenour, New York, N. Y.; Samuel Insul, Chicago, Ill. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) O. B. CAPEN, *Business Manager.*

Sworn to and subscribed before me this 6th day of October, 1922.

Paul M. Bone.

(Seal) My Commission expires March 30, 1924.

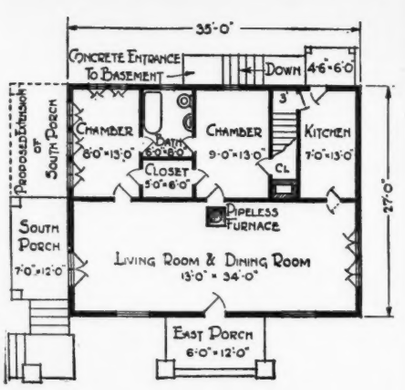
THE HOME WORKSHOP

Office Man Tells How He Built His Own Home

By R. J. Stephens, Rosedale, Kan.

(Submitted in the contest, "How I Made Money with My Tools")

WITH the skill in using tools that I had acquired in my home workshop, I built the home illustrated almost entirely by myself, with very little ready cash, and in the face of unexpectedly discouraging circumstances. The work was done in my spare time while I was employed as a credit man and accountant. My wife and I were able to raise the frame and complete the building in the early morning and evening, on holidays and during one week's vacation. It meant considerable self denial and hard work, but by keeping before us the vision of our home as we had first planned it on paper, we succeeded at last in freeing ourselves from the galling yoke of the landlord.



The one-man house when finished and the floor plan from which it was built

To start with, we owned a 50-ft. lot representing an investment of $750. With what little we could scrape together and borrow on the lot we had about $500 in cash and we figured that by economizing and taking our pleasure in planning and building the house instead of spending money for amusements, we could set aside a good part of my monthly salary for our building fund. So we obtained literature and books on home building and finally arrived at a plan of a house that could be constructed along simple lines without sacrificing beauty and comfort, and I prepared working drawings.

Although I had been a clerical worker for 18 years and had never done mechanical work for a living, I had a fairly good set of tools and knew how to handle them, because I had always been making something for the house. To learn more about actual building construction, I made Sunday trips with my wife and baby to study new houses in course of construction, so

(Continued on page 117)

THE HOME WORKSHOP

Office Man Builds His Home

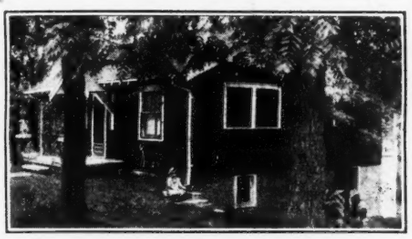
(*Continued from page 116*)

that before a sod was turned I knew exactly how our home was to be built from start to finish and how it would look when done, even to the color combinations.

We rented a cheap cottage with a good-sized barn close to the property. I rigged up a workshop in the barn and made all the door and window frames, porch columns, porch and gable brackets, porch beams, and everything possible before commencing the house proper.

The excavating work was done in July at a cost of $35 and then, with the occasional assistance of my wife, I constructed the concrete forms for the foundation. I wanted to shun the concrete work, but the best figure on the job, material furnished, was $400, so into the mammoth mold I wheeled and mixed by hand 40 cu. yds. of concrete. This cost about $150.

Through August and September I worked on the frame and had the house under cover by October 17, ready for plumbing



The front and north end of bungalow

and plastering. At that time I fell from a scaffold and broke a leg, and later my wife and baby were both seriously ill, so that work on the house was delayed until the following summer. When the plumbers and plasterers had finished, I laid the oak floor and had it dressed with an electric sanding wheel at a cost of $30. Then I finished the floors myself and we moved in. There was no inside trim, but the place looked well to us and, in spite of the handicaps of accident and illness, we were in our new home in a little more than a year after we started it, and our rent stopped.

House and Lot Cost $3200

We kept books carefully so that we knew exactly what each item cost. By keeping constantly on the lookout for bargains in material, the entire cost, including the lot (but not interest on borrowed money), was $3200. No mill work was used except sash and doors. The entire carpenter work, brickwork, concrete, painting and decorating, lighting, and even laying the terrazzo bath floor were done by the writer. The pipeless furnace, which cost $200, was installed by the dealer.

It may seem impossible that I could finance the building of a home estimated conservatively at $5000 on so little cash, but we had mastered the art of saving and economizing, and my credit was established with my bank and local dealers. We were able to divert at times as much as half my salary into the building fund. As our home neared completion and increased in value, the bank was ever ready to advance the money, although the most I ever owed was $1000. It was difficult to satisfy my creditors at all times, but somehow or other I kept my appointments and paid them as agreed.

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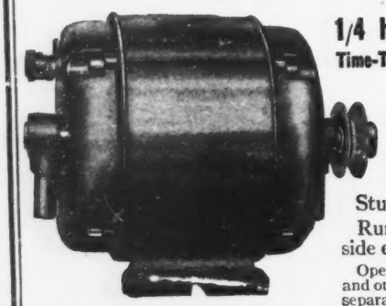

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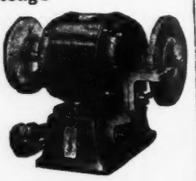

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How to Do the Odd Jobs

Repairing Pipes

A SATISFACTORY temporary repair of a leaking water or steam pipe, even if it is subject to considerable pressure, may be made by wrapping the pipe with a long strip cut from an automobile inner tube. This should be stretched tight as the wrapping proceeds, and the rubber, when in place, should be covered with several layers of tire tape. This will last until the plumber comes.

To make a more permanent repair, the wrappings are bound as tightly as possible with wire and the ends of the wire are twisted together.—C. O. SOOTS, North Salem, Ind.

Stopping Leaks

LEAKS in the house water supply are often discovered when the water system is thawed out after having been badly frozen. The first thing to do is to shut off the water in the cellar and let the water drain from the house pipes as far as possible by opening the faucets.

If a plumber cannot be had immediately, dry the pipe at the place where it is broken and smooth any rough edges. Coat the pipe with shellac and apply a patch of tough wrapping paper. Brush the patch with shellac and while it is drying prepare several strips of old cloth about 2 in. wide. Give the pipe another coat of shellac and wrap the strips around it like a surgeon's bandage. Fasten it with shellac or adhesive surgical tape.

Paraffin or melted candle grease will serve instead of shellac, but, in that case, the pipe to be mended should be warmed before applying it.—R. L. T.

Filling Cracks

I HAVE found that cornstarch mixed with linseed oil to the consistency of a heavy dough makes a good crack filler for floors. A small amount of drier may be added to hasten the drying.

This paste works better than putty and is cheaper than crack fillers on the market. It can be used without a putty knife by working it into the cracks with the thumb and then wiping up with a cloth small particles remaining on the surface.

The cracks should be cleaned out well and given a coat of oil or paint before anything is done. If the putty is next to the bare wood, the wood will absorb much of the oil with the result that the putty will work out of the cracks in time. It is also necessary to see that all loose boards are nailed down before the cracks are treated with the cornstarch filler.—C. O. S.

Finishing Asbestos

TO GIVE a good finish to the asbestos insulation used for boilers, apply a finishing coat of one part of plastic asbestos and one part Portland cement mixed together. Further protection will be given the surface if it is painted with a white lead oil paint.—R. S.

THE HOME WORKSHOP

Stand Set into Ironing Board Saves Effort

TO SAVE my wife the trouble of lifting a 6-lb. electric iron to and from its stand, I made a stand set flush into the ironing board as shown. The stand was cut from 1/16-in. copper to a size and shape approximately 1 in. larger all around than the bottom of the iron.

I crowned the plate up about ⅛ in. as shown, and then cut an opening in the

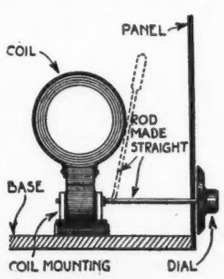
A slightly crowned copper plate is fastened over opening cut in ironing board

board ½ in. smaller all around than the copper. I recessed the edges of this opening sufficiently to let the margin of the copper in flush with the top of the board. Several ⅛-in. holes for ventilation were drilled through the plate to prevent a hot-air pocket being formed below.

Since the plate is crowned, the iron does not touch the board itself even when it is not placed squarely on the plate and projects a trifle over the board.—GEORGE STEITZ, St. Louis, Mo.

Dial Knobs Will Control Triple Honeycomb Coil Mounting

IT IS not difficult to mount triple honeycomb coils back of the radio set panel in such a way that the adjustment can be made with knobs and dials. The only drawback lies in the necessity for opening the cabinet or reaching over the top of the panel when coils of other sizes than those regularly used have to be plugged into the mounting.



The mounting is placed behind panel

If the mounting is already on the front of the panel, remove it and straighten out the two control rods. Then drill two holes in the panel far enough up from the bottom and the correct distance apart to allow the ends of the rods to be passed through them when the mounting is fastened to the base of the set. Two 45-degree dials and knobs are then fastened to the ends of the rods in front of the panel. It probably will be necessary to solder a length of brass tubing on each of the rod ends before fitting and attaching the dials. —E. C. DIFFINE, Tonawanda, N. Y.

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